OCT 17 1923

GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

VOL. CLXIV. No. 3151.] LONDON, OCTOBER 3, 1923. [75TH YEAR. PRICE 1s.

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VOL. CLXIV., No. 3151.] WEDNESDAY, OCTOBER 3, 1923. [75TH YEAR.

EDITORIAL NOTES.

Gas-Works as the Centres of Town Fuel Supply. A Glasgow Example.

In the past there have been, time and again, men who have advocated the carbonization of coal at the pithead, the concentration of industries in the neighbourhood, and of plants for dealing with the secondary products, with the long-distance distribution of gas for domestic purposes. These men have been dreamers of the first order. They have pictured a condition of things to save coal transport; but they have never given adequate consideration to the financial aspects of the matter—for example, the costs of carbonizing coal and distributing gas and secondary products from the pithead throughout the country, as compared with the distribution of the coal (in which Nature has packed so much that is valuable) to be dealt with at the local gas-works. Had they done this, it would have been something. But it is not by any means merely a question of the relative cost of distributing coal on the one hand, and of distributing gas and secondary products on the other. The proposal embraces much more than that. There are considerable national, economic, and sociological questions involved. The scheme of pithead carbonization would mean the concentration of industries in proximity to the pits, in order to utilize the gas and the secondary products close to the seats of production. That would involve a fabulous amount of money, and would add to the cost of the distribution of gas and the other products about the country. There would be a vast migration of the industrial population to the new industrial districts. This form of concentration would not be an advantage to the country; and there would be the cost of making provision for their accommodation, to the great loss and disadvantage of the areas from which they came. The industrial impoverishment of the remainder of the country would be of an order that one cannot contemplate without a shudder. For instance, normally the aggregate spending power of the industrial part of the population is immense; and that spending power would become largely concentrated, instead of being distributed as now. Pithead carbonization would do much to shatter the present system of things. In short, it seems pretty clear that Great Britain would not, in the new state—pictured, but never materialized—be any better off, on balance, than it is to-day. Anyway, that is as we see the position, in considering not only the economics of pithead carbonization, but the consequences of it all.

But they are dreamers who have so schemed; and coal continues to be distributed about the country, and the provision still expands for its treatment at the seats of use of the primary and secondary products. Men who do not dream but consider practical facts in all their bearings—men who look not only at the central idea, but go outside it, and examine the consequences—are favourable to coal being utilized to the best advantage of the country generally, and for the development of the whole, and not for particularly favoured districts. They believe that national advantage in this matter lies in devolution, not in concentration. Thus it is that several scientific men, without bees in their bonnets, and whose mental equipment enables them to blend practical with theoretical considerations, are strongly partial to the continued circulation of coal, and its treatment locally, in order that there may be as much distributed benefit as possible. The trend of the report of the Fuel Research Board, for example, which led to the Gas Regulation Act, was distinctly towards gas-works becoming the centres of town fuel supplies. At any rate, everything recommended in that report directed to that end. That is the ideal which every progressive gas engineer and manager should have before him. It is in working to this ideal that the greatest prospect of progress lies. There is not the slightest reason why gas-works should confine their attention, their plants, and their methods to the provision of a gas which serves domestic purposes, and only partly satisfies the requirements of industry. A gas-works may possess a variety of producing plants, if they can provide for the distribution of two grades of gas to the industrial centres of their areas.

Consideration of this question is revived by the report from Glasgow that, after long deliberation by a Sub-Committee of the Gas Committee, the Corporation have endorsed their proposal to erect a five-unit battery of Maclaurin producers at (probably) the Dalmarnock station of the Gas Department. This must be taken as more or less a trial plant, seeing that, having a capacity of only 100 tons per day, it would not go far towards providing the citizens of Glasgow with a smokeless fuel, which is one of the objects in view in making the departure. The second object is to utilize the low-grade gas for boiler-firing at the new electricity generating station, which is situated about half-a-mile from the Dalmarnock Gas-Works. Who can tell what developments may arise from the experience that will be gained from this piece of enterprise? It will be watched with extreme interest by the gas profession; and we may be sure that, under the supervision of Mr. John W. M'Lusky, the Engineer and General Manager of the Gas Department, of whatever there is in the plant he will make the best possible use. A report on the subject by him, with an estimate by the Maclaurin Carbonization Company, Ltd., appears in our news columns. Mr. M'Lusky's report was prepared some time ago; and he then calculated that the gas could be "set down at 2·32d. per therm to make financial ends meet." But in the Maclaurin estimate, it is seen that the gas can be sold at 1·32d. per therm, providing there are no variations from the computed working expenditure and receipts from the smokeless fuel and other secondary products. According to Mr. M'Lusky, the gas can be made of a grade between 175 and 250 B.Th.U.; the estimate provides for 247 B.Th.U. gas. Although the five-unit plant has a capacity of 100 tons per day, the estimate is on the basis of 250 working days, and a throughput of 25,000 tons. Much depends on the security of the estimated revenue. It is calculated that there will be available 10·96 cwt. of solid smokeless fuel per ton of coal carbonized, or 13,700 tons from the 25,000 tons of coal. Will the public purchase this fuel? Credit is only taken for it at 28s. 6d. per ton; and, at present prices of household coal, there would be a ready sale for it at something beyond that figure. The production of 15·6 gallons of oil per ton is entered up at 4d. per gallon. Sulphate of ammonia is credited with 17·3 lbs. per ton at ½d. per lb. Why only ½d.? Are the Maclaurin Company looking forward to the time when, through intensive competition, we shall only be obtaining £4 13s. 4d. per ton for this secondary product? Anyway, for standard quality sulphate of ammonia, we can at present reckon on obtaining 1½d. per lb. As to gas, the production of 247 B.Th.U. gas is placed at 68·4 therms per ton; and this could be sold (on the basis of making both ends meet, which is manifestly that taken for the other products) at 1·32d. per therm. The total therms available from

25,000 tons of coal would be, in 250 days, 1,710,000. The estimate of revenue, having regard to to-day's market values, is a very conservative one; there is scope in it for profit, with coal costing £1 per ton. The price of 1·32d. per therm is dearer than would be a potential therm in coal at £1 per ton. With a coal having a potential heating value of 28 million B.Th.U. per ton, a therm would cost 0·86d. But there will be a considerable difference between the efficiency and the duty obtainable from the boilers in favour of gas-firing as compared with coal-firing. Capital expenses and working expenses should also be much lower. There will be no coal to handle and burn, and no clinkering to be done. The whole tale is not by any means told by the estimate we publish from the Maclaurin Carbonization Company.

This is largely a pioneer trial. We wish it every success. It may be the beginning of making the Glasgow Gas-Works, at some date, the central fuel depots for the city—smokeless gaseous and solid fuel. Who can tell? It is interesting sometimes to look forward and endeavour to visualize those things that may be. It will not be in our time; but we should like to live in those days that we have occasionally pictured, when the only place where coal will be delivered in a city or town will be the gas-works, and when coal merchants and chimney sweeps will be known no more—at any rate, only as figures moving among us in these (viewed from the future) antiquated days in which we now live.

"Competent and Impartial" Gas Examiners.

The Gas Referees have issued a revised form of their Memorandum on the appointment, &c., of Gas Examiners. This document is sent by the Referees to the local authorities concerned and (or) Quarter Sessions, when an Order is made by the Board of Trade under Section 1 of the Gas Regulation Act, 1920, and subsequently when the question again arises as to the appointment of an examiner in any area. The Gas Examiner is a person whose appointment is most important from many standpoints, seeing that, if there is to be smooth working, he must unquestionably possess the necessary competence for the performance of his functions, he must be absolutely impartial, and withal conscientious. He is the person standing between the gas suppliers and the public; and he cannot have a leaning more one way than the other. To both he owes a duty, which is protective of, and an assurance to, the interests of both. It will be remembered that, during the therm charges inquiry by the Departmental Committee of the Board of Trade, a strong endeavour was made by the Institutes of Chemistry and Physics to get the Committee to express an opinion in favour of the positions of gas examiners being preserved for the members of those two scientific organizations; in other words, that they should be recognized as having a preferential claim to them on the ground of superior qualification. The Committee closely questioned one of the Gas Referees, Mr. W. J. A. Butterfield, on this particular point. He very properly refused to commit himself to any expression of opinion that the necessary qualifications did not reside elsewhere than among the members of the two institutions concerned; and he showed regard particularly for the long experience in the work of testing of already existing examiners, many of whom are not members of the two bodies who urged through their representative before the Committee the special qualifications of their members. In their report, the Committee made a statement on the subject which reflected their views; while (the matter being outside their purview) not making any positive recommendation regarding it. With their views, there is full concurrence; and we hope that they will always be borne in mind by the appointing authorities. In the first place, there was endorsement by them of the opinion that men of scientific training should be selected; but they would not suggest a definite standard, having in view the fact that officers who have for some years made tests, and have become familiar with the work to be undertaken, may be fully competent to perform the duties satisfactorily. There was a further suggestion, to which we will refer presently.

The views of the Committee had been already anticipated by the Gas Referees; and the fact is worth noting, now that the appointment of examiners is growing in importance through the increasing number of gas undertakings that are coming under section 1 of the Gas Regulation Act. Reminder is given by the Gas Referees, in the revised "Memorandum" just issued and reproduced in our columns to-day, of their ideas on the question of "competence" and "impartiality." The Therm Charges Committee were of opinion that "consideration could usefully be given to the "question of prescribing a minimum qualification for future "appointments." The Gas Referees may have given consideration to this expression of opinion; but, if they have the issue of the revised "Memorandum" without a prescription of minimum qualification is evidence that they have not succeeded in formulating such a standard. In this matter the difficulties of making a prescription, it is obvious, would be very great. But if those responsible for making the appointments of examiners will only bear in mind the general indications given by the Referees as to the type of man required for the work, they will not go far wrong. Super men are not necessary. An examiner, the Referees point out, should have a "sufficient" knowledge of physics, and chemistry to understand thoroughly the tests to be applied to the gas. It is also important that he should be a person accustomed to making quantitative measurements, the accuracy of which he is prepared to sustain under cross-examination. A person of good professional standing as an analyst or engineer, and with experience of the physics and chemistry of gas, would be suitable. This indicates clearly that a certain specialized competence is necessary, and that, under the new order of things, just any one who may be available for the work will not do. Now that the Gas Regulation Act has distinctly raised the standard of gas testing, and has imposed greater obligations on gas suppliers, they are as anxious for a high grade of efficiency and accuracy in the examiners as in the instruments they employ. This brings us to the second point made by the Referees—that, in regard to "impartiality," it is obviously undesirable that the examiner should be in the employ of the gas undertaking, or should have any financial interest in it; and when the local authority owns the gas undertaking, he should not be an employee. These are suggested rules which, if not observed, might lead to all sorts of dissatisfaction, innuendoes, and complications. In all cases, the personal standing and professional qualifications of the examiners should be such as to inspire the confidence of the public and managements of gas undertakings. Given that confidence, very little can, or should, go wrong.

In all these matters which contribute to the building-up of a new system, we want *ab initio* to get on to lines which will engender the feeling that smooth-going will have some chance of permanence. There have, however, been indications that some local authorities are taking to their new responsibilities and work in a perfunctory manner. The Therm Charges Committee had apparently received evidence of this; for in their report they remarked: "We "strongly deprecate any tendency on the part of local authorities to place the appointment of gas examiners open to "tender to the cheapest bidder; and we are of opinion that "it is to the best interests of gas consumers that the most "efficient men available should be appointed." There is something highly inconsistent in associating with the Gas Regulation Act and the science of gas-testing instruments and methods cheap men and incompetence, in view of the responsibility attaching to the position. There is no need for this. It will serve nobody's purpose that such conditions should exist. It will only be making provision for trouble in the future. That has to be avoided. But there are ways and means for securing high-class service; and one method is suggested in the final paragraph of the Referees' Memorandum. It is pointed out by them that needless duplication of testing-places and overlapping of the work of gas examiners will be avoided, and economy and efficiency in gas testing will be promoted, if local authorities enter into arrangements for the joint appointment and employment of gas examiners, or in suitable cases arrange for the appointment to be made by the County Council. The Referees promise that, when formulating their prescriptions for particular gas undertakings and areas, they will endeavour to provide for the full advantages of any such arrangements being reaped. Economy may legitimately be brought about by such arrangements; but economy must not be sought at the expense of efficiency in such work, by awarding the position to the man who assesses the value of his services (perhaps perfectly legitimately and honestly) at the lowest point. Against that there must be rigid resolution.

This question of the appointment of competent and impartial gas examiners has, in our opinion, an equality in importance with the provision of a dependable recording calorimeter.

Electric Cooking and Heating Losses with Current at Low Rates.

An article, based on actual experience, which should be a warning to electrical competitors who are seeking to develop domestic consumption other than for lighting, at exceptionally low rates, is contributed to our columns this week by an esteemed correspondent in Canada. He prefers anonymity. Nevertheless, it will be sufficient for us to say that he holds a responsible position in the gas world of Canada, and has intimate knowledge of those things upon which he writes. There are three points presented in this article which, at the outset, we desire to emphasize: The first is that Canada through its enormous water power is able to deliver to the local distributors electrical energy at prices the lowness of which cannot be matched in any part of the world where the primary power for generating purposes is provided by the combustion of solid, oil, or gaseous fuel. The second point is that, notwithstanding the pre-eminent advantage in cost over the greater part of the rest of the world, the local distributors of the energy, through the low prices at which (compulsorily) they have been attempting to cultivate domestic electric cooking and water heating, are finding this business an embarrassment, and they are now actually losing upon it, and wish to raise the charges The third point is that, despite this low-priced competition, the gas undertakings have held their own very well through the years when manufacturing and other costs were against them; and now that their costs are descending, and the electricity suppliers are anxious to convert a losing domestic branch of their business into a paying one by raising prices, the prospects are more open and brighter for the gas undertakings. It has to be remembered in reading the article that the conditions referred to as hitherto existing are without compare—to the advantage of electricity and against gas; and yet, while gas has suffered, it has not done badly, and the electricity people are not satisfied by results which do not spell gain, but loss, and are therefore a detriment to the other branches of their business. Just think of this—electricity is being sold for cooking and water heating, at many centres, for ½d. per unit, less 10 p.ct. for prompt payment. At Ottawa, the cooking and heating rate is only ¼d. per unit. Notwithstanding this exceptionally severe competition, our friend "Canadian" writes: "It is pleasing to report "that many of the Canadian gas companies and municipally operated gas utilities are holding their own, and, in "a number of cases, actually increasing their sales." We congratulate our Canadian colleagues both on what they have done, and on their improved prospects owing to the lesson that has been administered by experience to the electrical competitors.

In no part of the world are there electrical conditions resembling those existing in Canada. In Ontario, the Hydro Electric Power Commission have had far-reaching powers conferred upon them by the Legislature; and their authorization includes not only the right to charge for the current delivered in bulk, but arbitrarily to fix the local rates for the various classes of business in electricity. One idea of the formation of Joint Electricity Authorities in this country is that any economic advantage—if any—derived from concentration of generation shall be passed on to the local consumers; but the Joint Authorities have not the power to fix the local charges. The unique authority possessed by the Hydro Electric Power Commission has led to a curious state of affairs. They fix the local rates not in the interests of the vendors of the current, but in their own. Their interest is to build-up the power load to an extent which will absorb their capacity to produce. Hence they have thought that the development of electric cooking and water heating would assist them; but now it is found that this runs-up the peak load, which—being a factor in the conditions of payment by the local distributors to the Hydro Commission—has a very detrimental effect on their fortunes. The result is cooking and water heating have increased the payments to the Hydro Electric Power Commission, but have lessened, in proportion to business done, the net revenue of the local purveyors of the current. In other words, while the great hydro electric development has proved eminently successful in reducing costs for power, lighting, and industrial service, these have, under present conditions, to bear heavy cooking and water heating losses. The matter is being taken up by several of the local authorities, with a view to an effort being made to secure the adjustment of the retail charges for cooking and water heating, so that this part of the business may not prove wholly disastrous to the fortunes of the distributing undertaking. Other factors have also operated in increasing the cost of the cooking and water-heating load—such as the necessity for enlarging feed wiring, increasing the size of transformers, sub-stations, &c.

Our correspondent gives information as to the method of basing charges that obtains in some cases. The basis is a fixed charge per consumer per month—*plus* a charge for actual current used. But there seems to have been no alteration in the fixed payment with the increase of connected load. It is therefore proposed to urge that the connected load of appliances other than for lighting fixtures should be ascertained, and a definite monthly charge per horse power of possible demand should be imposed. This will mean a material increase of the charges; but something has to be done, otherwise the losses on the new classes of business will increase. The local vendors of electrical energy are apparently firmly and rightly agreed that the lighting and power consumers should not be injured by the consumption at unremunerative prices of current for cooking and water heating. It is not fair. One of the incidental benefits of making an adjustment of conditions of charge will be that the gas undertakings will be relieved of the unfair competition to which they have been exposed for some years. The experience in Canada suggests that there is a point at which the rateable value or floor-space systems in this country may become unremunerative or will be less remunerative, unless the primary or secondary charge is constantly being adjusted to circumstances. Under these systems, the economical consumers pay more on the average per unit than the uneconomical ones.

The Education Scheme.

Any great change in methods and organization takes time to bring about. With the best will in the world, and the most spirited working, there are bound to be hindrances to rapid completion through various causes—particularly when the change involves the co-operation of several parties. This has been the case in connection with the bringing of the new technical education scheme into action this winter. But by good effort on the part of the principals in the promotion work, and co-operation by others, the arrangements are so far advanced that a start can be made; but there is still more rounding-off to be done to give the scheme the fullest possible application throughout the country. This is obvious from the article that Mr. Walter Hole, the Organizing Secretary to the Scheme, contributes to our columns this week. The article shows how all may help, particularly intending students. Their prompt notification to sit for examination will assist the promotion of gas courses at technical institutions where there are not any at present. The desire is to establish the educational facilities on as broad a base as possible; but to effect this there must be the necessary students. There is quite a variety of information in Mr. Hole's article, which all interested in the scheme—and who is not in the gas industry?—should absorb.

National Gas Exhibition.

The events of the week at Bingley Hall, Birmingham, have been highly interesting. Notes regarding them appear on p. 47, together with a report of a joint meeting of the Birmingham and Midland Section of the Society of Chemical Industry and the Midland Junior Gas Association.

"B.C.G.A."

The annual conference of the British Commercial Gas Association started in Birmingham on Monday. The report of the three days' proceedings will be a feature of next week's issue of the "Journal."

Next Year's Exhibition.

The considerable success of the National Gas Exhibition in Birmingham this year adds to the interest of looking forward to the demonstration that gas will contribute to the vast exemplification of the might and progress of our industries and trade at the British Empire Exhibition next year. We see from their "Bulletin" that the Society of British Gas Industries have decided to co-operate with the National Gas Council and the British Commercial Gas Association in a combined exhibition there. The members of the Council representing all sections of

the Society have been nominated on the General Committee; and in the work of the Executive Committee Mr. Frederick C. Tilley, Mr. J. Wilfrid Drake, Alderman George Clark, and Mr. F. J. Gould will take part. Electricity will occupy a large place in the spectacular lighting display at the exhibition; but in domestic and industrial utility, the gas industry must make, and can make, a show which will rival anything that can be done by the Electrical Development Association, who are quietly pushing forward to secure funds for the purpose. All shoulders to the wheel, please, on behalf of the gas industry!

Gas Companies and Relief of Unemployment.

With respect to Government financial assistance to local authorities and public utility companies for carrying-out works for the relief of unemployment, some question arose as to a statement, in a report of the Unemployment Grants Committee, to the effect that in the case of public companies similar terms would be granted as to local authorities, subject to certain conditions as to limitation of dividends during the time that loans or advances from the Government were in operation. The National Gas Council took up the matter, and pointed out to the Committee that statutory control was already exercised in connection with both the price of gas and the dividends distributed by all statutory gas companies. Naturally, if further restriction or limitation of dividends were contemplated, no gas company would consider applying for Government assistance. Through the representations of the National Gas Council, the question has been finally settled by the Unemployment Grants Committee stating that, "in cases where dividends of undertakings are already limited by statute, further provision as to limitation does not, of course, apply." The Council have other points under discussion with the authorities; and early information may be expected in regard to them.

A Peculiar Form of Atrophy.

Our electrical friends are fond of thinking of the gas industry as gradually wasting away. Perhaps they will give attention to one or two figures which may assist to bring them back from the paths of delusion to those of right thinking. At the Joint Conference of Junior Associations and Salesmen's Circles (the proceedings at which were published in our Supplement last week), Mr. F. W. Goodenough pointed out that, during the last ten years, the increase in gas output for the country, as a whole, was 60,000,000,000 c.ft., compared with 45,000,000,000 c.ft. in the previous ten years. The figures look impressive; and they show a considerable rise in the rate of increase, despite wartime and the subsequent industrial depression. At the meeting of the British Gaslight Company last week, Mr. Henry Woodall stated that in 1871 the sales of gas at Hull amounted to 174 million c.ft., whereas to-day they are 1528 millions; and at Norwich the sales were 188 millions, compared with 741 millions to-day.

Gas Coal Exports.

The droop that coal exports recently experienced did not continue long; the quantity has again been on the rise in various departments, with the result that in August the total amount of coal exported was 6,580,410 tons, of a value of £8,314,710, compared with 6,146,121 tons in August, 1922, of a value of £6,873,551. Gas coal, however, did not show so well. The quantity shipped was 766,935 tons, as compared with 882,531 tons in August, 1922. The value of the gas coal shipments in August this year was £939,662, or an average per ton of £1 4s. 6d. The total shipments of coal during the eight months was 53,156,546 tons, as against 38,393,844 tons in the eight months of 1922—the respective values being £67,571,441 and £43,300,852. The quantity of gas coal shipped in the eight months was 6,211,911 tons, compared with 5,457,208 tons in the eight months of 1922. The respective values were £7,568,458 and £5,983,436.

Gas Coke Shipments.

Considering the period of the year, gas coke for export continued in good demand during August. The quantity shipped was 104,482 tons, as against 92,171 tons in August, 1922. The value in August was £172,640, as compared with £125,007 in the same month of 1922—the average value per ton in August this year being £1 13s. 0·5d. During the past eight months, 694,056 tons of gas coke have been sent abroad, compared with 474,212 tons in the same period of 1922. The respective values were £1,077,165 and £688,164. The increases in both quantity and aggregate value are highly satisfactory.

Sulphate of Ammonia.

It will be seen from a paragraph elsewhere that the British Sulphate of Ammonia Federation, Ltd., have raised their prices for October and November delivery by 2s. 6d. per ton per month. For this month the price will therefore be £14 12s. 6d. per ton, neutral quality, and 25¾ p.ct. ammonia, and for November £14 15s. The production of neutral and better-quality sulphate is becoming the general practice; and only limited quantities of ordinary quality (25¼ p.ct. ammonia) will be available in some districts, at 23s. per ton below the above prices. The exports of sulphate of ammonia still show an acute rise. The quantity shipped in August was 17,002 tons, as compared with 14,649 tons in August, 1922. The quantity exported in the eight months of the year was 161,148 tons, compared with 88,748 tons in the corresponding period of 1922—an increase of 81·5 p.ct.

The New Rating Bill.

Widespread interest is being taken in the Rating and Valuation Bill which has been prepared by the Ministry of Health. The underlying idea of the Bill is simplification of the rating system; whether or not it will (if it becomes law) achieve its purpose is a matter upon which an immediate pronouncement cannot be made. The draft of the measure may be subject to very material modification, seeing that the Government are taking the somewhat unusual course of submitting it to local authorities and associations representing public utility undertakings, the general body of ratepayers, and the chief industries of the country. By this means it is hoped to obtain a large representative expression of opinion, which can be weighed before the measure is actually presented to Parliament. In the reconstruction of a system of this kind, it is a sound policy to attempt in the process of rectification and simplification to obtain the best opinions, in order that the greatest value may be secured. It is understood that the rating of machinery is to be referred to a Departmental Committee; and proposals will not be formulated until the Government are in possession of the report of the investigators.

Some of the Reforms.

It seems clear that, if the new scheme as embodied in the Bill is carried out, with or without amendment, there will be simplification and improvement of the administrative machinery of rating and valuation, and the removal of various anomalies inherent in the present system. It is proposed that a single valuation shall be substituted for the separate valuations required for the purposes of rating and taxation. The promotion of uniformity of valuation is also an object. It is proposed to effect economies by avoiding the duplication of work and the unnecessary expense occasioned by separate valuations for the purposes of rates and taxes. It is considered, too, that the abolition of the obsolete valuation of each parochial section of railways and other undertakings as a separate entity might be abolished. It is intended to reduce the number of rating authorities from 12,882 to 648 in the rural areas of England and Wales, and from 2664 to 1119 in the urban areas. In boroughs and urban districts, a consolidated general rate is to be substituted for existing separate rates. It will be a voluminous measure, of which these points represent only a few of the central features. In a recent speech, Lord Eustace Percy, the Parliamentary Secretary of the Ministry of Health, stated that the Government scheme is based on four main propositions: (1) Taking the existing units of local administration, the country should be divided into rating areas reasonably corresponding to these units, with the result that rating machinery will be divided over some 1750 areas instead of some 15,500; (2) within each such unit area the three functions of valuation, rating, and expenditure should be discharged in partnership, and duplication of valuation and rating should be abolished; (3) in each area the aggregate cost of the various public services for which the area is responsible should be equally distributed among the ratepayers on the basis of a single uniform valuation; (4) the realization of these reforms will make possible an early and comprehensive review of the relations between Imperial and local taxation, and will provide the necessary foundation for a reformed system of Exchequer grants.

PERSONAL.

Mr. Leslie P. Ingram, M.Sc. (son of Mr. Samuel J. Ingram, of Truro), Assistant Engineer and Chemist at the Plymouth Gas-Works, under Mr. Percy S. Hoyte, has been appointed Assistant Engineer and Manager of the Truro Gas Company, and will take up his new duties on the 1st prox.

Mr. J. Davis, who is leaving the employ of the Wakefield Gas Light Company to become Distribution Superintendent to the Sutton Gas Company, was presented last week with a gold watch, as a token of esteem, by the staff and employees at Wakefield. The presentation was made by the Engineer and General Manager (Mr. C. W. Ward), who said Mr. Davis, in his capacity as Distribution Superintendent, had contributed largely to the increase of 25 million c.ft. in the sale of gas since his joining the undertaking. Mr. Davis, in returning thanks, declared that the secret of success at Wakefield had been their working well together.

The marriage took place on Sept. 25, at St. John's Cathedral, Portsmouth, of Mr. S. E. Whitehead, B.Sc.Eng., Assistant Engineer to the Portsea Island Gas Light Company, and Miss Caitlin Moya Mulvany, third daughter of Alderman Dr. John Mulvany, J.P., and Mrs. Mulvany, of Southsea. The numerous wedding gifts included a case of fish knives and a canteen of stainless cutlery from the Engineer and staff of the Company.

OBITUARY.

Mr. C. W. Offord, whose death, we are sorry to learn, occurred last Thursday night, was formerly General Manager and Secretary of the Enfield Gas Company, whose undertaking, as from the end of 1913, became part of the Tottenham District Light, Heat, and Power Company. Mr. Offord joined the Enfield Company in 1883; and the remarkable progress made during his thirty years' connection with the concern was shown by a diagram published in the "Journal" for July 21, 1914, together with information gleaned from an interview with Mr. Offord, who, on the amalgamation, it was then stated, changed the position he had hitherto held to that of Deputy-Manager of the Tottenham Company. Glancing again at the interview, one reason for the Enfield Company's great progress is seen in the remark that "not once during periods of strikes and high coal prices was the charge for gas increased while Mr. Offord was Manager; the movement in the downward direction was continued without ever looking back."

We regret to announce the death, after a brief illness of less than three weeks, of Mr. Robert B. Chalmers, Manager at Messrs. R. & A. Main's Gothic Works, Falkirk, N.B. Mr. Chalmers, who was only 38 years of age, had a lifelong connection with the gas industry. He was born at Alva, where his father was for many years Manager of the Gas Department. He served his apprenticeship as a mechanical engineer; and subsequently, on the death of his father, succeeded him in the managership. In 1913 he was appointed Gas Engineer and Manager at North Berwick, where he remained until 1915. At this stage he was asked by Messrs. R. & A. Main, Ltd., to join them in order to assist in reorganizing their works for the output of munitions of war; and it was due to his great mental capacity and ability that the firm were able to render such good service in producing munitions during the ensuing three years of war. In 1919 Mr. Chalmers was appointed Manager to the Falkirk Works on the retirement of the late Manager; and he held this appointment until the time of his death. His experience as a mechanic, combined with his thorough knowledge of all things appertaining to gas, rendered him a valuable assistant to the firm; and his loss will be greatly felt. Mr. Chalmers leaves a widow, but no children.

The death occurred, on Tuesday of last week, in his 65th year, of Alderman Charles F. Dixon, Managing Director of the Cleveland Bridge and Engineering Works. He entered the Darlington Town Council in 1904; and was well known for his good work on the Gas Committee. After holding for a brief period the office of Vice-Chairman of the Committee, he was appointed Chairman in 1915, and held the office until his death.

Gas Manufacture.—We have received from Messrs. Longmans Green and Co., of No. 39, Paternoster Row, E.C., a copy of a new book on "Gas Manufacture" by Dr. W. B. Davidson, M.A., Ph.D., D.Sc., F.I.C., Consulting Chemical Engineer. The price of the book is 21s. net. A review will appear in due course in the "Journal."

Westminster Technical Institute.—From the Principal (Mr. J. Stuart Ker, B.Sc., Assoc.M.Inst.C.E.) we have received a copy of the prospectus for the session 1923-24 of the Westminster Technical Institute, Vincent Square, S.W. In this will be found, among much other information, particulars of the classes in gas supply, which have for so long been a feature of the work carried on. The Advanced Class in Gas Supply, which was formerly conducted by Mr. D. J. Winslow, has now been taken over by Mr. E. L. Oughton. Other classes are taken by Messrs. P. Smithers, F. B. Bellamy, H. S. Tutton, W. Dieterichs, and J. Hewitt. Courses for gasfitter apprentices are in the hands of Messrs. Steed, Smithers, Snell, and Ferne. Syllabuses and times will be found in the prospectus.

ELECTRICITY SUPPLY MEMORANDA.

Our electrical contemporaries are constantly, and very properly, denouncing the all too prevalent practice of municipal authorities appropriating profits derived from a public service to relieve the general rates. This being so, we have confidence that we shall have them with us, though perhaps not overtly, in the protest that was made in the "Journal" last week regarding what was called "An Alloa Scandal." This refers to something which, in our opinion, is deplorably scandalous in respect of municipal management, and which shows a total disregard of the ethics of financial administration. The Alloa Town Council will say they have a legal right to do what they are doing; but the legal right does not alter the fact that what they are doing will be described by many people as immoral. There was no compulsion to get into the mess that they have done in connection with the finances of their electricity supply undertaking, and there was no obligation upon them, having got into the muddle, to inflict the accumulated electrical losses on the gas consumers, instead of upon the ratepayers generally. We return to the subject this week because the notes in the "Memoranda," we have good grounds for knowing, are largely read by electrical men, while subjects dealt with in other parts of the "Journal" may escape their notice. The story is simply this: The electricity undertaking has standing against it an aggregate of losses amounting to £32,446; and it is calculated there will be a loss of £3000 this year, and what is going to happen afterwards, no one can foresee. But anyway it is roughly computed that there is £40,000 that has to be obtained from somewhere. In 1890, an Electricity Supply Act was passed for Scotland, which amended (through a schedule) a previous Act in such a way that one of the sources of revenue from which deficits on electricity undertakings could be made good was the rents and rates of municipally owned gas undertakings. There was no National Gas Council in those days, or such a gross piece of injustice would not have been allowed to pass without serious challenge and an attempt made to prevent such a disgraceful piece of work (as we view it) becoming an accomplished fact. In 1919, Paisley had recourse to that Act; and the gas consumers had to pay a big deficit incurred in supplying the electricity consumers. Now the Alloa Council have decided that the helpless gas consumers shall find the whole of the money to liquidate the big indebtedness of the competing electricity concern. The price of gas this year could have been reduced from 2s. 11d. per 1000 c.ft. Instead, the price is to be raised by 7d., which it is estimated will yield £6000 a year; and this is to go on for some seven years until the electricity undertaking is free of its heavy burden, which is the product of the past three or four years. That is the method imposed by the Alloa Town Council to discharge this debt, and all connected with the electricity undertaking must be thoroughly ashamed of the fact. Electricians who read this note will agree with us, and not with the (in this matter) Alloa local misgovernment. Supposing the boot had been on the other leg, what an outcry there would have been!

How to Liquidate Deficits.

A Super-Tax for Gas—A Reduction for Electrical Energy!

The Council had an option as to the course they should pursue. They could have taken the more sensible one of placing the charge on the ratepayers generally; but they preferred to have recourse to indirect taxation, and to put a super-tax, under the name of an increased charge, on the gas consumers. It is an elementary principle that taxation should be distributed equally over the general body of ratepayers; but this elementary principle has been ignored by the Alloa Town Council, and the gas consumers have to pay for the shortcomings of the electricity concern. By no twist of the imagination can even a shadow of justice be found in this proceeding. The fact of this charge being a super-tax upon the gas consumers is only one objectionable aspect of the matter. That the gas undertaking has to bear the burden built-up by the undertaking which competes with it, and does its best to take business from it, is a condition that is distinctly Gilbertian. And while the price of gas is going up by 7d. specially to wipe out the electricity undertaking's losses, the price of electrical energy to the power users is to be reduced 15 p.ct., in order to induce them not to transfer from public supply to private generating plant. We shall be interested to see any comments our electrical contemporaries have to make upon this unsavoury and inequitable state of things. Perhaps as they cannot (if they believe in British fairplay) say anything in defence of what is being done in Alloa, they will discreetly pass over the matter in silence.

Fires and Other Things.

When something happens which touches electrical interests adversely, "Meteor" of the "Electrical Times" pokes fun at it, or calls it unkind names. The Royal Commission on Fire Brigades and Fire Prevention in their recently issued report made some excellent suggestions regarding electric wiring. They considered that electrical installations should be periodically inspected and tested, especially in the case of old buildings, and that defective installations should be brought up to modern standards. That is quite sound advice; and the Com-

mission ought to know of what they are talking after the large amount of evidence they heard, and the close investigation they made. But "Meteor," who did not hear the evidence, nor joined the Commissioners in their investigation of the matters brought before them, characterizes the report as a "silly" one. We do not suppose this will hurt the Commissioners' feelings, or detract in any way from the serious attention that will be given to the recommendations. The electrical people—"Meteor" among them—know full well that fires are caused by defective and obsolete wiring. But because short-circuits frequently cover-up effectually their mischievous operations by burning-out all traces of the originating cause—well then, of course, it is only, electrically viewed, surmise that the cause was electrical. We suppose "Meteor" will say that the recent disastrous fire at the works of the Shelton Iron, Steel, and Coal Company, Ltd., was not due to fusing in connection with an electric motor; and anyone must be very silly to entertain any notion that the fire at the extensive flour-mills of Messrs. Hanley & Sons, at Doncaster, was likewise due to the fusing of an electric wire. We have a dozen friends who can point to damage caused in rooms by fusings; and there has been no doubt about them. Fortunately they were discovered in time to prevent the continuing of their fell work. Perhaps a fire that was started in one of the windows at Harrod's Stores was not caused by electricity; and perhaps it was very wrong to say that often recent fires were started electrically because there was nothing else that could produce fire in the particular spot where they originated. Perhaps a man was not killed through electric shock the other week at the Hindsford Foundry, Horwich, though a coroner's jury say he was. Perhaps, too, it was all a myth that the electric light failed at Walham Green during the evening of last Saturday week; and perhaps it was only a dream that at one of the busiest hours, on the evening of Sept. 24, at the great letter-sorting office at King Edward Building, E.C., and the parcel-sorting office at Mount Pleasant, as well as at the post office attached to King Edward Building, the electric light failed. A thousand candles had to be brought into use—the humble stand-bys to electricity. Special care had to be taken to guard the doors while these conditions prevailed. The electrical journalists always jeer and laugh at those who "attribute" fires to electric fusings. But how do the electrical journalists know that there is not more solid foundation to the "attributed" cause than their own jeerings possess? Even their own readers must sometimes smile at their assumption of an all-seeing knowledge of things from which they are far separated.

Electric Furnaces and Economy.

Automatic and Electric Furnaces, Ltd., apparently feel somewhat hurt over the reference made in the "Memoranda" to their large "Wild-Barfield" internally heated furnaces for economically carburizing steel parts. As they consider our remarks are likely to mislead, they ask us in common fairness to give their letter prominence "so that the cheapness of running electrically heated furnaces may be appreciated." We are always prepared to do things in common fairness; and therefore prominence equal to that given to the remarks of which complaint is made will be obtained by including the letter in the "Memoranda." Here it is:

In your issue of Aug. 1, you kindly make reference to our large internally heated Wild-Barfield electric furnaces for economically carburizing steel parts. You close your remarks by a somewhat damaging statement as to the question of these furnaces being economical. We have not only obtained running costs on a modern London gas plant, but to make still more certain we have obtained the leading maker's figures for a new furnace which we find requires 480 c.ft. per hour for one-and-a-half to two hours, and approximately 180 c.ft. per hour to maintain at 900° to 1000° C. A corresponding Wild-Barfield electric furnace consumes 14 KW. for two hours and 7 KW. afterwards. Taking a period of two hours for heating-up, and five hours at steady temperature, the electric and gas furnaces become equal in the cost of running when electricity costs 1d. per unit and gas 2s. 10d. per 1000 c.ft.

In most towns, therefore, the electric furnace will work out somewhat the cheaper. As the closing remarks of your editorial notice are likely to mislead, we would ask you in common fairness to give this letter equal prominence, so that the cheapness of running electrically heated furnaces may be appreciated.

On the data as presented, the costs work out precisely the same—5s. 3d. But our correspondents must know that in the industrial North gas is being supplied in many places to manufactories at much below 2s. 10d. per 1000 c.ft. Take Widnes, for instance, gas is being supplied there for power and furnace purposes at 4·17d. to 3·13d. per therm. On the data mentioned by our correspondents, 63 KW. are used by their furnace in the seven hours—this being the equivalent of 215,460 B.Th.U. In the same time, the gas used in the gas-furnace on the figures quoted is 1860 c.ft. The calorific value of the gas is not stated by our correspondents, although in these days a vital matter in comparisons. Assuming it is 500 B.Th.U. gas, this would mean that 930,000 B.Th.U. would be expended in the seven hours. Our correspondents seriously suggest that the efficiency of the gas-furnace is so low that it takes 930,000 B.Th.U. supplied by gas to maintain the requisite temperature and do the work performed by 215,460 B.Th.U. supplied by electricity? We are not sorry they did not mention the names of the makers of the gas furnace, as this might have necessitated another reference in a subsequent issue of the "JOURNAL."

Private Electricity Generating Plants.

Now that the price of gas has descended so considerably from the peak points to which it ascended during and subsequent to the war, a great deal more attention is being paid by gas undertakings to the question of the provision of private generating plants for large consumers of electrical energy for both lighting and power purposes. Such plants have a distinct pull over the town supply of electric current, in that the owners can reckon that they only pay the average cost per unit for the electricity generated—no matter the purposes of use—instead of a high price for lighting units and a lower one for power when obtained from the town supply cables. A very useful article in this connection was that which was contributed to "THE GAS SALESMAN" by Mr. W. A. Tookey, and published in the Supplement to the "JOURNAL" last week. The article should do a great deal to stimulate the responsible officials of gas undertakings to take up this line of business, and not to accept the assertion of electrical salesmen that the electric motor can beat the gas-engine for all small factory power requirements. That is a statement which can, on Mr. Tookey's showing, be strongly contested. As Mr. Tookey points out, even the big generating station at Greenwich cannot produce more cheaply than at 0·59d. per unit, while the average works costs for twenty-eight electrical undertakings in the Metropolitan area are just over 2d. per unit, which means a commercial cost of from 2½d. to 3d. per unit by the time special payments and expenses on capital have been met. Therefore, the average revenue must exceed 3½d. per unit. Mr. Tookey knows about these things; and it is interesting to have his testimony as to cinema proprietors, as well as manufacturers, installing private generating plants, using town gas for the purpose, and proving considerable savings as the result. He quotes the imposing instance of one South London cinema, the private generating plant costs of which are 50s. a week for gas, when formerly the bill for electricity was 120s. to 160s. a week or thereabouts. Many large drapery firms, too, now have their own generating plants; and this would not be the case if it were not financially worth while. As Mr. Tookey says, gas consumers generally, and even some gas salesmen, do not realize that it actually is possible to generate electricity with town gas for less than the charges for current by electrical undertakings. We merely point in this place to the article, in order that its lessons may not be missed by those who read these notes, but probably do not concern themselves much with the contents of "THE GAS SALESMAN." The data given in the latter part of the article will be very useful to the members of gas sales staffs who are starting-out to exploit this particular line of business.

Lamp Voltages and Costs.

An instructive article has appeared in the "Electrical Times" on the "Importance of Using Lamps at Rated Voltages." It is by Mr. W. Milner, B.Sc., of the Lighting Service Department of the B.T.H. Company. From it we take some extracts, which need no comment. Mr. Milner first points to the great increase of efficiency that has taken place in electric incandescent lamps, and he mentions the well-known fact that a small change in filament temperature has a great effect on the output of light from a lamp. A reduction of 1 p ct. in the temperature of the filament causes the light output to be lowered by as much as 11 p.ct. A large number of people attempt to reduce their lighting accounts by installing lamps of a higher rated voltage than that of the circuit to which they are connected. In this way, the renewal charge is reduced; but the loss in efficiency is out of all proportion to the saving effected, with the result that the actual cost of the light produced is increased. A 10 p.ct. reduction in applied voltage reduces the light output by 32 p.ct. Again, owing to the temperature co-efficient of tungsten, the reduction of current through the lamps is not proportional to the reduction in voltage. This is advantageous in that it makes the lamp—not entirely, but to some extent—self-regulating on fluctuating voltage. Take a 100-watt 100-volt gasfilled lamp. It is found from the makers' lists that the light output is 1300 lumens, and the list price is 5s. For 1000 hours' normal life, the energy consumed by the lamp at 6d. per unit is 50s. The total cost of supplying 1300 lumens for 1000 hours (what of light depreciation?) is 50s., *plus* 5s., or 55s. If the same lamp is operated at 10 p.ct. below the rated voltage, the light output is reduced to 68 p.ct. of the normal or, instead of obtaining 1300 lumens from the lamp, only 885 lumens are realized. A curve showing the relation between wattage and voltage indicates that the reduction of 10 p.ct. in voltage causes the lamp to consume only 84½ p.ct. of its normal consumption; in other words, the nominal 100-watt lamp at 10 p.ct. reduced voltage consumes 84½ watts. Therefore, the energy cost of supplying 885 lumens for 1000 hours is 42s. 3d.; and it is assumed that, by reducing the voltage, the life of the lamp has been doubled (which is a generous assumption, as mechanical breakage will probably prevent this figure being reached). Thus the cost for renewal per 1000 hours is 2s. 6d. Therefore, the total cost of 885 lumens for 1000 hours is 42s. 3d. *plus* 2s. 6d., or 44s. 9d. At this rate, the cost of 1300 lumens for 1000 hours would be 65s. 6d. Thusit is seen that, instead of saving money by installing lamps of higher rated voltage than the circuit, it actually costs 10s. 6d. more to obtain 1300 lumens for 1000 hours. The economy of a lamp cannot be judged by the number of hours it will burn; and efficiency is by far the most important factor affecting total cost.

APPOINTMENT, QUALIFICATIONS, AND DUTIES OF GAS EXAMINERS UNDER THE GAS REGULATION ACT, 1920.

Revised Memorandum by the Gas Referees for the Information of Local Authorities and Quarter Sessions.

THE Gas Regulation Act, 1920, provides that the charges made by gas undertakings for the public supply of gas shall be based on its heating or calorific value, and that official tests shall be made by gas examiners for the purpose of ascertaining the calorific value, purity, and pressure of the gas. In the event of the official testings showing that the average calorific value of the gas in any quarter is less than it should be, a proportion of the revenue of the gas undertaking has to be applied to a reduction of the price of gas in a subsequent quarter.

Under the Gas Regulation Act, 1920, the examiners provided for by the Act are appointed by local authorities or Quarter Sessions. The sections or sub-sections relating to the appointment, qualifications, and duties of gas examiners, and the provision of testing-places and apparatus for use by them are as follows:

4.—(3) The local authorities may, unless they are themselves the undertakers, appoint a competent and impartial person to be a gas examiner, and subject to the prescription of the Gas Referees to test the gas and the pressure at which the gas is supplied: Provided that—

(*a*) for the purposes of this section, a gas examiner may be appointed to act on behalf of any number of local authorities, and the local authorities may enter into such arrangements as they think fit in regard to the joint appointment and employment of such gas examiner; and

(*b*) any county council may, if they think fit, with the consent of any other local authority within the county, appoint a gas examiner, who shall have the same powers as if he were appointed by that local authority.

(4) Where no gas examiner is appointed by the local authority, or where the testing of gas is imperfectly attended to, Quarter Sessions, on the application of not less than five consumers, may appoint a competent and impartial person to act as gas examiner, who shall have the same powers and perform the same duties as if he were appointed by the local authority; and the remuneration and expenses of the gas examiner, up to an amount approved by Quarter Sessions, shall be paid by the local authority.

5.—(1) The Gas Referees shall prescribe—

(*a*) the places and times at which, and the apparatus and method by which, tests, whether continuous or intermittent, shall be made to ascertain whether any undertakers with respect to whom an Order has been made under this Act are supplying gas in accordance with their obligations; and

(*b*) the method by which any such apparatus shall be verified; and

(*c*) the time and form of the reports to be made by the gas examiner to the Gas Referees and the local authority or Quarter Sessions by whom he is appointed, and to the undertakers, and the means by which the results of the tests shall be made available to the public:

Provided that, unless otherwise agreed between the undertakers and the authority by whom the gas examiner is appointed, any testing-place provided by the undertakers in pursuance of any Special or other Act of Parliament, relating to the undertaking shall be deemed to be a prescribed testing-place under this section; but the Gas Referees may, if they think fit, prescribe any additional testing-place in respect of that undertaking.

(3) Any undertakers with respect to whom an Order has been made under this Act shall provide and maintain to the satisfaction of the Referees the prescribed testing-places and apparatus, and shall give any gas examiner access to any testing-place for the proper execution of his duty.

18. For the purposes of this Act:

The expression "local authority" means the Common Council of the City of London and any county, county borough, or urban district council, and in relation to any gas undertaking means any such local authority the whole or any part of whose area is within or partly within the limits of supply of the undertakers.

The expression "gas undertakers" or "undertakers" means any local authority, company, body, or person authorized to supply gas by any Act of Parliament, or any Order having the force of an Act of Parliament.

The expression "Quarter Sessions" in relation to any undertaking means the Court of Quarter Sessions for the county, division, or place in which the gas-works of the undertaking are situate.

20. The expenses of a local authority under this Act shall be defrayed, in the case of the Common Council of the City of London out of the general rate, in the case of a county council as payments for special county purposes made in respect of the parishes which are wholly or partly within the limits of supply of any gas undertakers in respect of which the county council have power to appoint a gas examiner, and in the case of other councils as expenses incurred in the administration of the Public Health Acts, 1875 to 1908.

21.—(1) In the application of this Act to Scotland, references to the Sheriff shall be substituted for references to Quarter Sessions, the expression "local authority" means the county council and the town council, and the expenses of a local authority under this Act shall be defrayed, in the case of a county council, out of the general purposes rate, provided that, notwithstanding anything in the Local Government (Scotland) Act, 1889, the ratepayers of any police burgh shall not be assessed by the county council for any such expenses, and in the case of a town council out of the burgh general assessment or police rate.

As regards "competence" of gas examiners, the Gas Referees consider that it is important that a gas examiner should have a sufficient knowledge of physics and chemistry to enable him to understand thoroughly the test to be applied to the gas. It is also important that he should be a person accustomed to making quantitative measurements, the accuracy of which he is prepared to sustain under cross-examination. A person of good professional standing as an analyst or engineer, and with experience of the physics and chemistry of gas, should be suitable.

As regards "impartiality," it is obviously undesirable that the gas examiner should be in the employment of the undertaking, or should have any financial interest in it; and that, when the local authority own the undertaking, he should not be an employee of the authority.

In any case the personal standing and professional qualifications of the gas examiner should be such as to inspire the confidence of the public and of the management of gas undertakings.

When a gas examiner is appointed, a deputy similarly qualified should, where practicable, also be appointed to act in his temporary absence.

The foregoing opinion of the Gas Referees on "competence" and "impartiality," reproduced from previous issues of this Memorandum, is supported by the following extract from the report to the Board of Trade of the Therm Charges Committee (Cmd. 1825, price 6d. net):

54. It has been represented to us that gas examiners appointed by local authorities should be possessed of certain scientific qualifications. Whilst we in general endorse the opinion that men of scientific training should be appointed, it is not within our duties to recommend a definite standard, especially in view of the fact that officers who have for some years made tests and become familiar with the work to be undertaken may be fully competent to perform their duties satisfactorily. We strongly deprecate, however, any tendency on the part of local authorities to place the appointment of gas examiner open to tender to the cheapest bidder; and we are of opinion that it is to the best interests of gas consumers that the most efficient men available should be appointed.

Consideration could usefully be given to the question of prescribing a minimum qualification for future appointments.

The apparatus and method by which tests are to be made are described fully in the "General Notification of the Gas Referees," which may be purchased through any bookseller, or directly from H.M. Stationery Office at the following addresses: Imperial House, Kingsway, London, W.C.2, and No. 28, Abingdon Street, London, S.W. 1; York Street, Manchester; No. 1, St. Andrew's Crescent, Cardiff; or No. 120, George Street, Edinburgh. Price 1s. net.

The times and places at which tests shall be made are prescribed by the Gas Referees in a Special Prescription for each undertaking. Subject to certain general provisions embodied in the General Notification as to hours, days of the week, and supplemental testings, the intervals of time between visits of the gas examiner to the testing-place will be, in most cases, approximately as follows:

For gas undertakings supplying:

More than 1000 million c.ft. a year: One each day (for the present).

Less than 1000 million and more than 500 million c.ft. a year: Twenty-six each quarter.

Less than 500 million and more than 250 million c.ft. a year: Thirteen each quarter.

Less than 250 million and more than 100 million c.ft. a year: Seven each quarter.

Less than 100 million and more than 50 million c.ft. a year: Three each quarter.

Less than 50 million and more than 20 million c.ft. a year: Two each quarter.

Less than 20 million c.ft. a year: One to two each quarter.

The time needed for each visit will usually be from two to three hours.

Where the undertaking has more than one works, or any detached gasholder station, the Gas Referees will usually prescribe more than one testing-place. In that event, or in cases where more than one testing-place prescribed under previous enactments are retained, provision must be made for attendance of a gas examiner at each testing-place.

Needless duplication of testing-places and overlapping of the work of gas examiners will be avoided, and economy and efficiency in gas testing will be promoted, if local authorities enter into arrangements for the joint appointment and employment of gas examiners, or, in suitable cases, arrange for the appointment to be made by the county council. When formulating their prescriptions for particular undertakings and areas, the Gas Referees will endeavour to provide for the full advantages of any such arrangements being reaped.

THE REGENERATIVE COAL GASIFICATION SYSTEM.

A Process for the Complete Gasification of Solid Fuels.

By Morris W. Travers, D.Sc., F.I.C., F.Inst.P., F.R.S., and Frank William Clark, M.I.Mech.E.

1.—In these notes we propose to describe the construction and operation of a new plant for the complete gasification of bituminous coal and the production of town gas, which has been in regular operation during the past six months, supplying a considerable proportion of the gas consumed in the Aylesbury district. This system, the result of an investigation into the problem of the complete gasification of coal, commenced some eighteen months ago, introduces a new principle into the production of town gas, the development of which has been embodied in the complete gasification machine erected and herein described. We may say at the outset that the results obtained in the daily operation of the machine are closely in accordance with the conclusions arrived at on a theoretical basis; and as we believe our conclusions and experimental results throw new light on the general problem of complete gasification, we have included in these notes a detailed account of the considerations upon which this new regenerative system is based.

2.—These notes have been divided into numbered paragraphs, which in turn are grouped into sections, arranged in two parts. First, the more practical considerations and summary of results are given (paragraphs 3 to 31), followed by an account of the theoretical basis on which the system is founded. Paragraph 3 gives a general summary of the contents.

3.—Contents.

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PROCESSES FOR THE COMPLETE GASIFICATION OF COAL.

4.—The gasification of bituminous coal in such a manner as to leave as a residue only ash and clinker can be effected by processes which fall into three categories, two of which only, (*a*) and (*c*), are of practical interest.

(*a*) By the continuous action of a mixture of air and steam on the fuel, the gaseous products having a calorific value rarely exceeding 170 B.Th.U., or 93 C.H.U., per c.ft. In this, known by the general title of the producer gas process, the available energy of the gas produced is a larger proportion of the available energy of the fuel than in the case of the gas produced by any other known and practical plant; or, in other words, its thermal efficiency as expressed by the formula

$$\frac{\text{heat units in gas} \times 100}{\text{heat units in solid fuel}} = \text{thermal efficiency}$$

is the highest known. The production of producer gas is of immense importance in industry; but the gas has too low a calorific value and too high a nitrogen content for service in the gas industry.

(*b*) The gasification of coal by an analogous process, using oxygen in place of air, would yield a producer gas almost free from the nitrogen, which is necessarily present as a diluent in common producer gas, and having a calorific value of the order of twice that of the latter. This process has only been studied from the theoretical standpoint, as the cost of manufacturing oxygen does not make the further study of it likely to be profitable.

(*c*) Processes depending upon the alternate action of air and steam upon the fuel for the production of gas having a calorific value in the neighbourhood of, or exceeding, 300 B.Th.U., or 170 C.H.U.,* and containing only a small quantity of nitrogen. As the process which we are considering comes within this category, we will discuss some of the practical points involved.

MODIFICATIONS OF THE WATER-GAS PROCESS OPERATING WITH COAL.

5.—In the simplest of the processes falling under the third heading, an ordinary water-gas plant is used, and operated with coal in place of coke. The working of water-gas plants with coal has been the subject of several investigations carried out by the American Bureau of Mines. The conclusion arrived at is that the efficiency of the process, represented by the relationship between the calorific value of the gas and the calorific value of the coal from which it is produced, is low. The quality of the gas produced is usually approximately equivalent to that of water-gas, and the yield appears rarely to exceed 35,000 c.ft. per ton of coal.

6.—In this process both the blow gas and the water gas pass through the whole depth of fuel in the gas producer. Though the blow period is only a fraction of the run period, the sensible heat of the blow gas is double that of the water gas (par. 56), so that a very considerable part of the distillation process is effected by the blow gas, and much of the rich distillation gas is carried away and lost.

7.—Attempts have been made to modify this process by arranging the plant so that, while the water gas traverses the whole depth of the fuel bed, the blow gas is taken away at a lower level through openings in the walls of the gas producer. The results of our theoretical investigation (par. 66), which are fully confirmed by practical results (par. 27), prove, however, that the heat required to carbonize the coal in this process is of the order of two-and-a-half times the heat available from the water gas generated from an equivalent quantity of coal. The complete gasification of coal cannot then be efficiently carried out by this modification of the water-gas process, as the coal is incompletely carbonized in the zone above the take-off of the blow gas, and carbonization is completed at a lower level, at which the coal is subject to the action both of the blow gas and water gas, with consequent loss.

8.—With the intention of supplying the additional heat, over and above the heat available as sensible heat in the water gas, generators have been constructed in which the lower part is similar to an ordinary water-gas generator, the upper part forming a retort into which coal is fed from the top, the water gas only passing through the coal; the blow gas passing outside the retort through channels, in which it can be burned with secondary air. Consideration of the published facts in connection with vertical retorts used in the manufacture of town gas, indicates that the temperature difference within and without the retort section of the plant must necessarily be relatively small; and the diameter of the retort being necessarily large, very little advantage is to be derived from this arrangement. The fact that published information as to the working of plants in this and other countries constructed on these lines shows the gas to have a calorific value rarely exceeding 316 B.Th.U. and to contain 35 p.ct. of carbon monoxide and very little methane, confirms this view.

9.—We will not stop to discuss the construction and working of other modifications of the water-gas process for the gasification of coal, in which the gases flow alternately upwards and downwards through the fuel beds in two or more generators. Not only are such modifications complicated, but when the distillation gas from one generator is passed through the region of very high temperature in a second generator or generators, the decomposition of the hydrocarbons and the production of a gas of low calorific value necessarily result.

PRINCIPLE OF THE NEW REGENERATIVE COAL GASIFICATION SYSTEM.

10.—In paragraph 4 (*a*) the process giving the highest efficiency in gas production is mentioned, and the reason this gas cannot be used as town gas is given. An important item of the task we set ourselves some eighteen months ago was to investigate the possibility of applying to the production of town gas the principle upon which this producer-gas process derives its high efficiency—this in such a way that the nitrogen and other inerts in the resultant gas should not be greater than is produced by existing gas-works plant. If this could be done, the efficiency in the production of town gas could be increased. A prolonged study of the problem

* In the theoretical part of this paper we have used the cubic foot, pound, and Centigrade degree as units for measurement, and consequently also the Centigrade heat unit, the amount of heat required to raise the temperature of water at 15° C. through one degree Centigrade. One C.H.U. is equal to 9/5 B.Th.U., and one C.H.U. per pound is numerically equivalent to one great-calorie per kilo. Data and constants based upon the metric system can therefore be used directly in calculations based upon the Centigrade-pound system.

led us to the conclusion that such a process could be devised; and as mentioned in the introductory paragraph, this new principle in the manufacture of town gas has been embodied in a practical plant which has now been working for over six months. The principle is applied in the new system in this way. In producer-gas practice the work done by the sensible heat of the nitrogen is applied directly by reason of its mixing with the combustible gas produced; whereas in the new regenerative system the work done by the sensible heat of the nitrogen and other inerts is applied indirectly, with the advantage that the nitrogen and other inerts are not mixed with the gas produced, and consequently the gas is of a much higher calorific value and suitable for town gas. Thus the principle on which the most highly efficient method of converting solid into gaseous fuel is founded, is now made available for the complete gasification of coal for the production of town gas in a single plant.

11.—In any modification of the water-gas or producer-gas processes, we may consider the fuel bed as divided into two zones in which different processes take place. In the upper or carbonization zone, the coal is distilled. It is an essential condition of efficiency that the blow gas shall not pass through this zone, the highest temperature in which must be limited to about 900° C., but only the water gas, or mixed water gas and distillation gas. In the lower, or gasification zone, the water-gas reactions operate, and in the lower part of it the temperature will vary between 1300° and 1400° C. The blow gas must leave the generator at a level intermediate between the zones of gasification and carbonization.

12.—As already stated—and the proof of this is given in the detailed consideration in the second part of these notes (pars. 32 to 69)—the sensible heat available from the water gas is of the order of only one-third of that required to carbonize the coal and to heat the resultant coke to near or above 800° C.; and as examination shows this deficiency cannot be supplied either by passing the blow gas through the coal, or by burning it outside a retort surrounding the carbonization zone, we decided to proceed as follows.

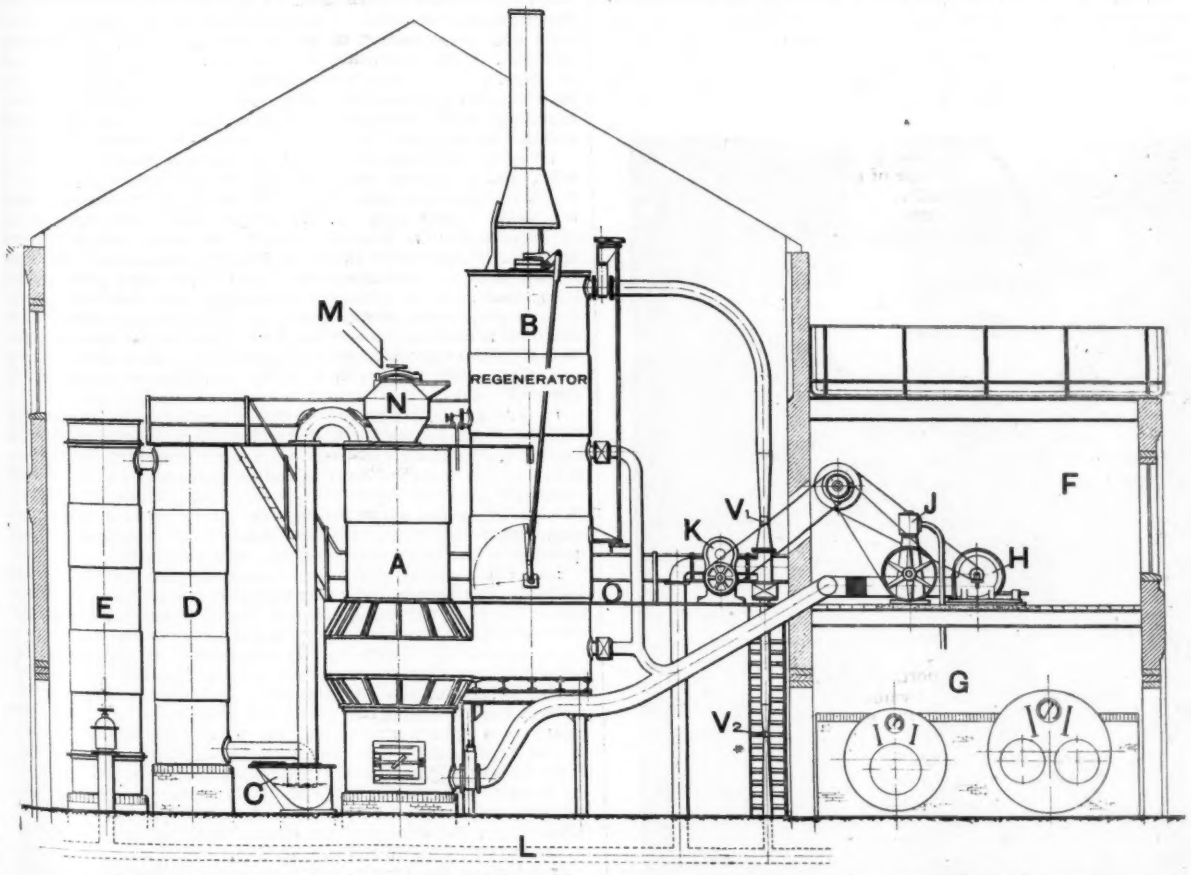
13.—The complete gasification machine which we have constructed consists of a deep gas producer, so arranged that the blow gas can be drawn off at a level intermediate between the gasification and carbonization zones, and led through a special channel into the bottom of a deep cylindrical vessel filled with chequer work, which serves as a regenerator. During the blow the gas passes into this vessel, together with secondary air, and the waste gases escape through a stack valve at the top of it. During the run the stack valve is closed, and the gas is caused to travel through the coal in the carbonization zone. To supply the additional heat required to complete the process of carbonization, a quantity of the gas, after it leaves the gas-producing machine, is forced by means of a special circulator into the top of the regenerator, and, passing downwards through it and being heated in the process, enters the channel through which the blow gas leaves the gas producer, and passes, together with the water gas generated in the gasification zone, through the coal in the carbonization zone. In this way use is made of the regenerative principle to recover the sensible heat of the blow gas; and we utilize it for the carbonization of the coal.

14.—It will be noticed that in the regenerative gasification process and in the operation of the steam-air gas producer, the carbonization of the coal, with the conservation of the combustible and volatile products, is effected by passing hot gas through the coal, which is often referred to as internal heating. In the producer-gas process, the gas may be considered as a mixture of the water gas and blow gas produced in the water-gas process, which carries with it, from the region of gasification, sufficient heat to effect the carbonization of the fuel. In consequence of this, producer gas contains a considerable quantity of nitrogen, from which town gas must be comparatively free; and to obtain the desired result, we utilize the heat in the blow gas indirectly, applying the regenerative system herein described.

15.—It will now be clear that the essential conditions which make for efficiency in plants of this type are rigorously fulfilled. Only water gas, or mixed water gas and distillation gas, pass through the distillation zone in the gas producer. The blow gas does not pass through the coal in the distillation zone, but is taken off at a lower level from the gas producer. Finally, the distillation gas, with or without admixture with the water gas, does not pass through the region of extreme high temperature in the lower part of the gasification zone, but is only subjected to the much lower temperature obtaining in the regenerator and region intermediate between the zones of carbonization and gasification.

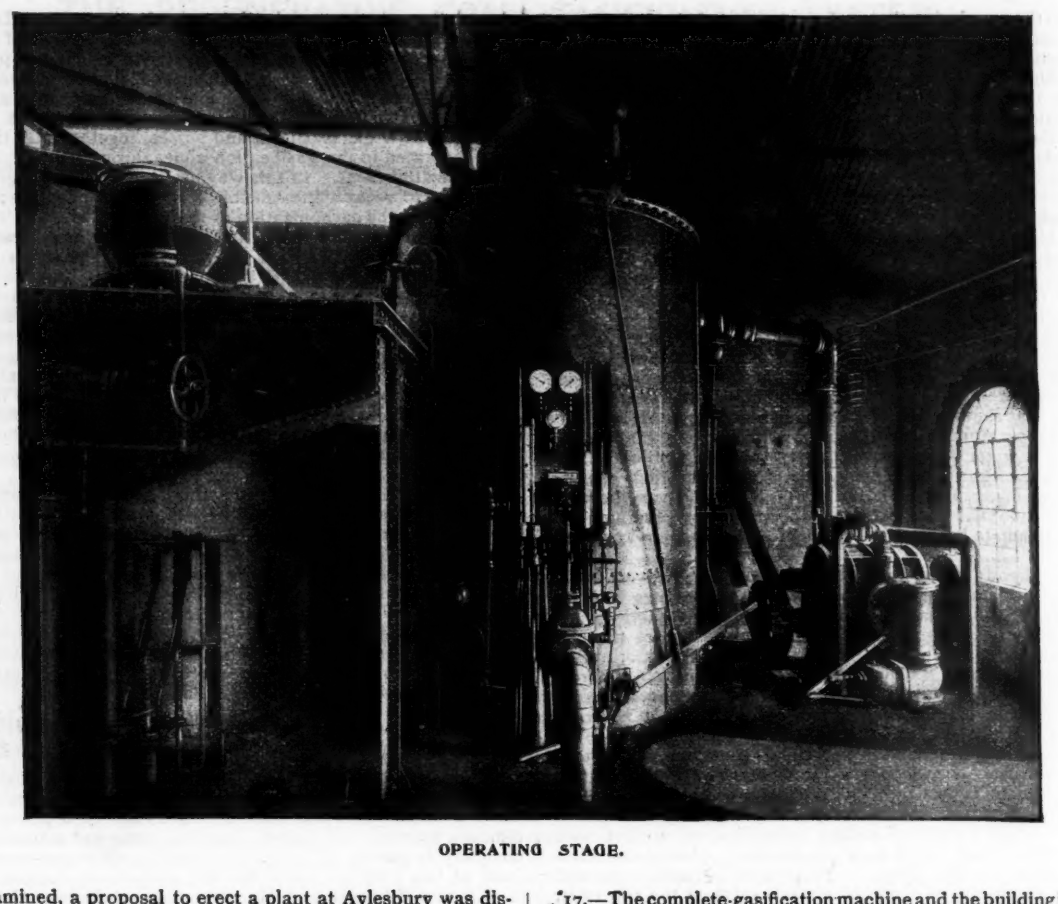
THE NEW COMPLETE GASIFICATION MACHINE AS ERECTED AT THE AYLESBURY GAS-WORKS.

16.—Detailed study of the physico-chemical and engineering aspects of the problem led us to the conclusion that the process was a practical one, and that the realization of it presented no difficulty greater than that of inducing some gas-manufacturing company to permit us to erect a plant in their gas-works. In June of last year we submitted the preliminary designs to Mr. A. G. Lane, Engineer and Manager of the Aylesbury Gas Company. After the technical aspects of the process had been care-



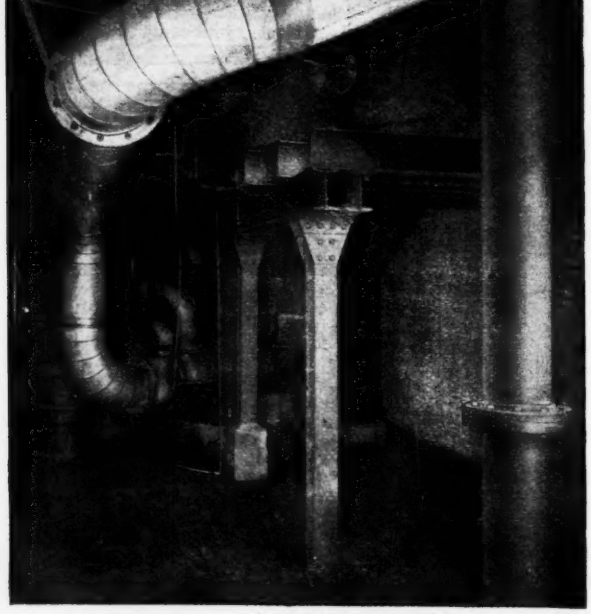
GENERAL ARRANGEMENT OF THE COMPLETE GASIFICATION MACHINE AT THE AYLESBURY GAS-WORKS.

A—Gas Producer. B—Regenerator. C—Wash Box. D—Scrubber. E—Condenser. F—Engine Room. G—Boiler House. H—Blower. J—Steam Engine. K—Circulating Machine. L—Outlet to Relief Holder. M—Coal Shoot (from Overhead Hoppers). N—Coal Charging Hopper. V_1—Venturi Gas Meter No. 1. V_2—Venturi Gas Meter No. 2. O—Operating Floor.



OPERATING STAGE.

fully examined, a proposal to erect a plant at Aylesbury was discussed between ourselves and Mr. Ball, Chairman of the Company, with the result that a contract was entered into for the construction of a complete-gasification plant rated at 300,000 c.ft. per 24 hours. The plant was constructed by Messrs. Travers and Clark, Ltd.; the machinery being provided by the Sturtevant Engineering Company, Ltd., and the vessels and refractory materials by Messrs. Gibbons (Dudley), Ltd.



Clinkering Space at Ground-Floor Level, showing Regenerator above.

17.—The complete-gasification machine and the building in which it is located are shown by the general arrangement drawing No. 1 and the two photographs. The machine was erected on the site previously occupied by a carburetted water-gas plant, which produced about one-third of the gas generated by the new machine. The existing boiler, blower, engine, scrubber and condenser, and certain gas connections were utilized with the least possible modification. Consequently the plant is somewhat cramped; while certain of the gas connections and valves were dictated by reason of economy rather than by design.

18.—The gas producer consists of a steel shell lined with firebrick and insulating material. The lower part is similar to a water-gas generator, having air and steam inlets provided with the usual valves and an off-take for the down-run gas, all arranged below the firegrate level. The lower part of the gas producer is referred to as the gasification zone, as in it the coke produced by the carbonization of coal in the upper part, or carbonization zone, is converted into water gas and blow gas by the alternate action of steam and air. The carbonization zone or chamber is continuous with the lower part of the gas producer, and is furnished with a coal hopper, a coal feeding device, and a gas off-take pipe leading through the scrubber and condenser to the outlet main.

19.—At a level in the gas producer intermediate between the regions of carbonization and gasification, a special channel is formed which communicates with the regenerator. The circulation gas is drawn from the outlet main and forced by the circulator into the top of the regenerator, the gas first passing through an orifice gauge. From the readings of a differential manometer connected to either side of the orifice gauge, the quantity of gas being circulated can be determined.

20.—The normal routine of operating the machine is as follows. During the blow, air enters through the connections under the gas producer grate, and the blow gas passes through the regenerator, escaping by means of an ordinary stack valve. Secondary air is admitted to the regenerator as necessary. At the end of the blow the air valves are closed, steam is admitted to the bottom of the gas producer, and, after allowing a few seconds for scavenging the plant, the stack valve is closed. By means of a special mechanism the valves controlling the gas to the regenerator, and steam to the circulator engine and to the blower engine, are operated simultaneously, the speed of the former being increased and of the latter decreased. The rate of circulation can be controlled by a valve in the inlet to the regenerator; the volume of gas circulated being read off directly on the gauge which we have referred to.

21.—During the up run, which occupies the first part of each run, gas is circulated through the machine. After stopping the circulation, and before commencing the down run, steam is passed into the top of the regenerator, so as to drive the gas left in it forward into the gas producer, and through the carbonization zone. The down-run valve is then opened. During the down

run the steam is preheated in the regenerator, so that at the end of the run period the regenerator contains steam only, and no gas is lost on commencing the blow.

22.—During the blow period rich gas, mixed with a large quantity of steam, continues to be given off from the coal in the gas producer. Much thought has been given to the means of avoiding loss of any of this rich gas. A method has been devised and patented whereby the mixture of gas and steam is passed into the condenser, and the permanent gas is drawn through the circulator and delivered to the holder. Though the volume of hot gas and steam is large, the volume of cooled permanent gas produced is in the Aylesbury plant of the order of 50 c.ft. per minute. The dilution of the gas by the steam as it leaves the coal makes it easy to avoid loss by diffusion downwards into the stream of blow gas passing to the regenerator.

23.—The circulator, on which so much of the mechanical efficiency of this process depends, is a Sturtevant rotary blower capable of handling the required quantity of gas against a high resistance. Although the duties of this circulator are by no means light, the machine has from the start behaved in a most satisfactory manner, and never in any circumstances has it given the slightest trouble.

PRACTICAL RESULTS OBTAINED BY THE NEW SYSTEM.

24.—The machine at the Aylesbury Gas-Works has been in operation for over six months, and during this time it has never been put out. Owing to the capacity of the new machine being larger than the present consumption, and as the blower, circulator, and other essential parts are not in duplicate, it was considered advisable to maintain a section of the retort bench in operation, thus ensuring continuity of the gas supply in the event of accidental breakage of any of the machinery parts; but nothing of this kind has happened. It has, therefore, only been possible to work the new plant intermittently, usually for between five and eight hours per diem. This has not interfered with the efficient working of the plant, for, even after standing over for eighteen hours, after clinkering the fire it is only necessary to lengthen the first few blowing periods before proceeding with the regular plant routine. The longer the stand-over, the more material was removed on clinkering; but the coke was easily removed from the clinker by forking, and either returned to the generator or burned under the boiler. During the first part of the stand-over a certain amount of rich gas is given off; but as the stack-valve is kept closed, this gas passes to the relief holder. Intermittent working does not involve material loss, but of course makes it more difficult to obtain an accurate record of output than with continuous running. It must be pointed out that intermittent working is a more severe test of a gas-producing machine of this kind than continuous working; and even more satisfactory results will follow when the machine is run continuously.

25.—Further, it must be pointed out that neither the boiler nor the blowing plant was designed for the machine. When the proposed new blowing and boiler plant are installed, it will increase the output per day and further improve the thermal efficiency.

26.—On a future occasion we propose to publish a more detailed account of the working of the plant; but the information given below represents the results arrived at after working for several months, and shows what number of therms per ton as town gas can be obtained by the complete-gasification process working on a practical scale. From time to time we have made measurements of the output of the machine and the calorific value of the gas manufactured, and during the month of July arrangements were made to carry out a test covering a complete fortnight. During this period, and for some days beforehand, the coal used was Maltby Main washed gas nuts, containing 3·75 p.ct. of moisture, the dry coal containing 6·61 p.ct. of mineral ash. It was clinkered each day before starting up, and the fire was slightly broken-up at the end of the dinner hour, but it was not otherwise touched during the day. The plant was operated from five to six hours per day. The material removed from the generator, while clinkering, was forked, and the coke returned to the plant. The refuse, which represented about 10 p.ct. of the fuel supplied to the plant, contained 63·9 p.ct. of mineral ash. Very little hard clinker was formed. The gas was collected in a relief holder, and passed thence through a station meter, by means of which the volume was measured and corrected to 15° C. (60° Fahr.) saturated.

27.—The calorific value of the gas was determined at frequent intervals. The mean corrected results are as follows:

	B.Th.U.	
July 11—Morning	379·5	
Afternoon	365·0	
,, 12—Morning	359 0	
Afternoon	355·5	
,, 13—Morning	413·0	
Afternoon	377·0	
,, 14—Morning	352·0	
Average	371·5	(206·5 C.H.U.)

28.—The composition of the gas, when the temperature of the circulation gas was below 35° C. (par. 69), approximated to

CO_2	5 p.ct.
C_mH_n	1 ,,
CO	27 ,,
CH_4	10 ,,
H_2	50 ,,
N_2	7 ,,

When the temperature of the circulation gas rose, higher values for the carbon dioxide content were obtained. Generally speaking, these results confirmed our anticipation as set forth in paragraph 63.

29.—During all tests the plant was operated by an employee of the gas company, without interference on our part. During the stand-over the stack-valve was closed, and the gas generated allowed to flow into the relief holder, or at times into a small holder, by means of which the volume of the stand-over gas could be measured and its calorific value determined. The quantity of gas generated in this way was almost exactly 4 p.ct. of the total make; and as its calorific value was 500 B.Th.U. (278 C.H.U.) per c.ft., an allowance must be made for it while calculating the efficiency of the process.

30.—The output of gas per ton of coal as supplied was found to be 47,500 c.ft. In round figures, the output of gas per ton of dry coal is 49,000 c.ft., and the calorific value of 96 p.ct. is 370 B.Th.U., and of 4 p.ct. is 500 B.Th.U. The output in therms per ton is

$$370 \times 0{\cdot}470 + 500 \times 0{\cdot}020 = 184.$$

The value in C.H.U. per ton is 102×10^5.

31.—Other experiments confirm the conclusion that the output from the machine may be reckoned at 180 therms per ton of coal, even when working discontinuously. To produce this result the amount of material handled was very much less than in any other process, and the space occupied by the plant itself and required for the storage of material is also relatively very small.

In concluding this section of the paper we wish to express our appreciation of the keen interest taken by Mr. A. G. Lane in the new process, and to thank him for the valuable advice and assistance which he has given. We are also indebted to Mr. Hendren, Foreman-Mechanic at the gas-works, for many valuable practical suggestions, and for assisting us in the construction of the plant and in carrying out the trials.

The theory of the process will be dealt with in the next issue of the "JOURNAL."

(To be continued.)

TREATMENT OF SPENT OXIDE.

According to "Das Gas- und Wasserfach," the Rhenania Company, of Mannheim, have patented a new process for recovering from spent oxide cyanogen compounds and high-percentage sulphur, leaving the oxide fit for further use. It consists in treating the spent oxide with a hot solution of sulphides or polysulphides of alkaline earths, and subsequently decomposing with sulphurous acid the polysulphide liquor formed. The result is a mixture of sulphur and sulphites of alkaline earths, while the cyanogen compounds remain in solution in the form of their earth-alkali salts, and can be worked-up by known methods. The separation of the sulphur from the sulphite follows by treatment with acid, and thus sulphurous acid is formed, which is used again in the process. The lixiviated oxide is regenerated as usual, and is then available for further purification work. The following example is given to illustrate the working of the new process: 2000 kilos. [about 2 tons] of spent oxide with about 50 p.ct. of sulphur content are mixed into 6000 litres of barium sulphide solution, which should contain more than 300 grammes BaS to the litre, and treated with heat. The lixiviated oxide is then separated by filtration from the barium polysulphide liquor which has formed, and the latter is treated with strong sulphurous acid. During this process, besides the sulphur extracted from the oxide, a considerable quantity results from the action of the sulphurous acid on the barium sulphide. Also the total barium separates out in the form of barium sulphite, while the cyanogen compounds remain in solution, and can be filtered off. The mixture of sulphur and barium sulphite is now stirred with hydrochloric acid. In this way sulphurous acid and barium chloride are formed, while the sulphur remains undissolved, and by filtration and washing can be prepared for whatever purpose required. The barium chloride is worked-up to a solid salt, and the ferrocyanide salts are taken out of the solution in the usual way, and worked-up to potassium ferrocyanide. The sulphurous acid is used again in the process.

Sulphate of Ammonia Prices.—We learn from the British Sulphate of Ammonia Federation, Ltd., that they are prepared to sell sulphate of ammonia for home agricultural use for October delivery at £14 12s. 6d. per ton for neutral quality in fine friable condition, free from lumps, basis 25¾ p.ct. ammonia. For November delivery, the price is £14 15s. In some districts limited quantities of ordinary quality will be available, and will be sold at 23s. per ton less than the above prices, basis 25¼ p.ct. ammonia.

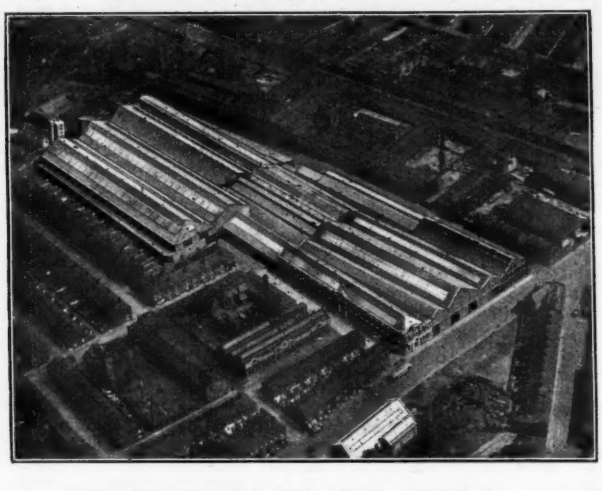
Wales and Monmouthshire District Institution.—There will be a meeting of the Wales and Monmouthshire District Institution of Gas Engineers and Managers in the Council Chamber, Gwyn Hall, Neath, at 11 o'clock on Thursday, Oct. 11, when Mr. W. C. Jackson (the new President) will deliver his address. Mr. B. S. Wrench will describe the National Oil Refineries, Llandarcy—which (together with the gas-works, of which Mr. Jackson is Engineer) will be visited during the afternoon. Luncheon at the Castle Hotel will be by invitation of Mr. Jackson.

THE ALBION IRONWORKS.

Products and Activities of Messrs. West's Gas Improvement Company.

We published, on pp. 931-4 of last week's "JOURNAL," an article entitled "Welfare at the Albion Ironworks," which described the function at the opening of a new canteen at the works on Friday, Sept. 21. The visitors on the occasion made an inspection of the finely equipped shops at Miles Platting; and as a souvenir of the event each received a beautifully prepared book descriptive of the firm's works and activities. From this is taken the following account of the source of the material so well-known to the gas industry.

Fifty years ago the foundation of the firm was laid in the machinery introduced by the late Mr. John West into the works of the Maidstone Gas Company, of which he was Engineer. The firm were actually incorporated on April 29, 1874; and on March 4, 1874, Mr. John West, as Managing Director, was authorized to take on a ten years' lease a factory and house situated at Waterside, Maidstone. In 1884 the Company acquired the Albion Ironworks, Miles Platting, Manchester.



The Albion Ironworks, Miles Platting, Manchester.

The Albion Ironworks then occupied a site of about 7500 sq. yds., with a frontage on Hulme Hall Lane, and extending along Norton Street. Some 3400 sq. yds. were occupied by covered shops, the machines and erecting space being in one bay, of which the smithy formed an extension. The works included a foundry, a small platers' shop (or boiler shop as it was then called), and a fairly extensive yard in which structural steelwork was erected. In 1891 the yard between the original machine shop and the northern boundary of the site was roofed over and utilized for general stores, and for the fitting and erection of stoking machinery. The platers' department was extended in 1912 by the roofing-over of a portion of what is now called "A" bay of the structural steel department. In 1913 the "B" bay was built, and the two bays were extended nearly to their present limits. The remainder of the structural steel area was roofed over just before the war, and formed a most valuable covered shop in which to engage in several of the branches of munitions manufacture which were allocated to the Manchester district. In 1915 two bays were added towards Grant Street, the frontage to which was occupied by a row of cottages which were not demolished until a later date. The erecting shop was now converted into an extension of the machine shop, and many special tools were installed; the new bays being occupied by the fitting and erecting appliances, a work-in-progress stores, and a chain-fitting shop.

WAR WORK—SHELLS, MINES, AND TANKS.

Such was the extent and equipment of the works when the demand for munitions came. The first and most obvious duty before the Company, when overtaken by the war, was to complete their contracts for vertical retorts. Their next was to ensure that existing installations of carbonizing plant—whether vertical retorts or the earlier horizontal and inclined retorts—were kept in that state of efficiency which was necessary if the country was to be maintained in running order during the war, and if the output of those bye-products of the gas-works on which the supply of munitions so largely depended was to be kept up. These activities called for all their resources up to 1916, when the Government made its demand for assistance in the manufacture of all kinds of war stores.

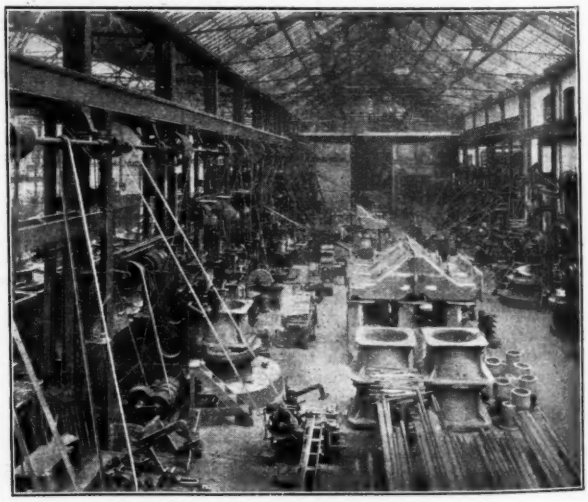
West's Gas Improvement Company entered whole-heartedly into the establishment of the Manchester and District Armaments Output Committee. The first call was for shells; and the Company's equipment of heavy machine tools enabled them to undertake the machining of the 6-in. H.E. shell for which there was a very great demand. The machine shops were completely rearranged, jigs and special tools were made, and a very large number of shell bodies was produced. The drop-forging apparatus, designed in the first instance for the manufacture of chain links, proved admirably adapted to the forging of shell-noses; and of these over a million and a half were produced and supplied to shell factories all over the country. But the structural steel shops proved of most value in this life and death matter; and before more than a few months had elapsed, one bay was given over entirely to the welding, fitting, and painting of contact mines, and other portions of the shop to the manufacture of mine-sinkers. Other minor activities were the manufacture of machine-gun mountings for the famous "pill-boxes" which did so much to stem the German tide in their great final effort of March, 1918, and of a number of parts of paravanes which contributed to the protection of our merchant marine from enemy mines.

The great effort was undoubtedly that of the manufacture of tank hulls. Messrs. West undertook as main contractors, in a combination of over thirty of the principal structural steel, boiler, and locomotive manufacturing firms in the Manchester district, a contract for the manufacture, in the first instance, of 1500 tank hulls. At the Albion Ironworks, in addition to a very full quota of machining and plating work, the hardening of all the armour-plate was undertaken. The whole of one bay of the structural steel department was given over to gas-fired heating ovens and oil quenching tanks. Shooting galleries were constructed at the end of the shops, in which bullets from captured German service rifles were fired at the hardened plates to prove that the process had been effective. The original intention to assemble and rivet the hulls in France having been abandoned, another two bays were subsequently taken up with apparatus for a considerable proportion of this work. Later on, other types of tank hulls were undertaken, when the happy conclusion of the war brought all to a standstill.

POST-WAR RE ORGANIZATION.

The armistice found the Albion Ironworks practically converted into a vast armament factory; and as at the same time the pent-up demands of gas-works at home and abroad for rebuilding and extension—a demand which had remained unsatisfied for five years—blazed up in the great post-war boom, it will be realized that only the most strenuous efforts could succeed in coping with this unprecedented situation.

One of the first requisites was office accommodation. The original offices at the corner of Hulme Hall Lane and Norton Street had been entirely outgrown; and though a contract had already been placed for new offices—a portion of the work was even done—it was necessary to make still further extensions on the existing site to accommodate the greatly increased technical and administrative staff required to deal with the expanding volume of business, and at the same time to proceed with the construction of entirely new office buildings. Steps were therefore immediately taken to remove the row of cottages in Grant Street and erect a suite of offices which would allow a sufficient margin for future extension. In April, 1921, they were ready for the staff to enter into occupation.



No. 2 Machine Shop.

The works, as existing to-day, are laid out in two main divisions—the machining and fitting department, in which the mechanical equipment of retort-settings and coal and coke handling plant are manufactured; and the structural steel department, in which retort-bench bracings, coal and coke bunkers, conveyor framework, retort-house buildings, and steel structures of all kinds are fabricated. The first division is laid out in two bays with machine tools—one bay for fitting and assembling and progress stores, and one bay for fitting and assembling conveyor chains. The smithy,

with electrically-driven drop forging apparatus, and with three powerful electro-pneumatic hammers, is also included in this division. The second division of the works—the structural steel department—forms one of the largest covered steelwork shops in the district. It is laid out in four main bays, served by overhead electric cranes and equipped with unusually heavy machinery for the shearing, rolling, drilling, and flanging of plates and rolled-steel sections. Stores of these materials are laid out on areas served by the cranes; and there are separate weighbridges, loading points, and dispatching exits for this department. The several bays are interconnected by transverse railways.

The shops are served by three 10-ton, one 7½-ton, five 5-ton, and one 2-ton electric overhead cranes with spans up to 68 ft. The whole of the machinery and line-shafting is electrically driven; alternating current at 420 volts being purchased from the Manchester Corporation. Main drives account for twelve motors aggregating 320 H.P., while many of the machines are driven by individual motors, bringing the total power installed up to 860 H P.

Machining and Fitting.

The main principle of the arrangement of the machine shops is that the machines are erected along the sides of the shops, being conveniently placed in relation to the line shafting, and so leaving the middle of the shops open for the temporary storage of the heavier castings and pieces being machined. In No. 1 shop, the original workshop, are placed the miscellaneous machines, including two heavy horizontal boring mills, which have been redesigned and converted for the simultaneous facing of both ends of the coke-chamber castings. Here also are located the planing, shaping, slotting, milling, and key-seating machines, together with lathes of all types. No. 2 shop is equipped with several vertical boring mills, which are specially useful for machining the coal valves, extractor worms, and other fittings of vertical retorts.

No. 3 shop is occupied by fitting benches and erecting space, and partly by the main portion of the progress stores, where all readily portable parts are inspected and checked between operations and finally passed as perfect before shipment. In this shop, too, are situated the tool department and the general stores. Adjoining the fitting shop is the chain shop, in which all types of conveyor, elevator, and driving chains are assembled, fitted, and packed for shipment. The various types of conveyor buckets are manufactured in the structural steel shops; but they are brought here to be finished and fitted to the chains.

The smithy has been recently converted to electrical drive throughout. It is fully equipped with smiths' hearths (mechanically blown), and a number of special furnaces and three powerful electro-pneumatic hammers. The most interesting feature of this shop is the fine set of heavy electrically-driven drop-stamps, with their accompanying finning presses and furnaces. In these, all types of stamped steel chain links are manufactured, as well as a variety of levers and fittings for carbonizing plants and coal and coke handling machinery.

Structural Steelwork.

The manufacture of structural steelwork is a process essentially different from that of the machining and fitting of mechanical parts. It is therefore organized independently under an assistant works manager. The shops are laid out in four main bays, and the whole of the work is carried out under cover—an enormous advantage from the point of view of avoiding corrosion during fabrication.

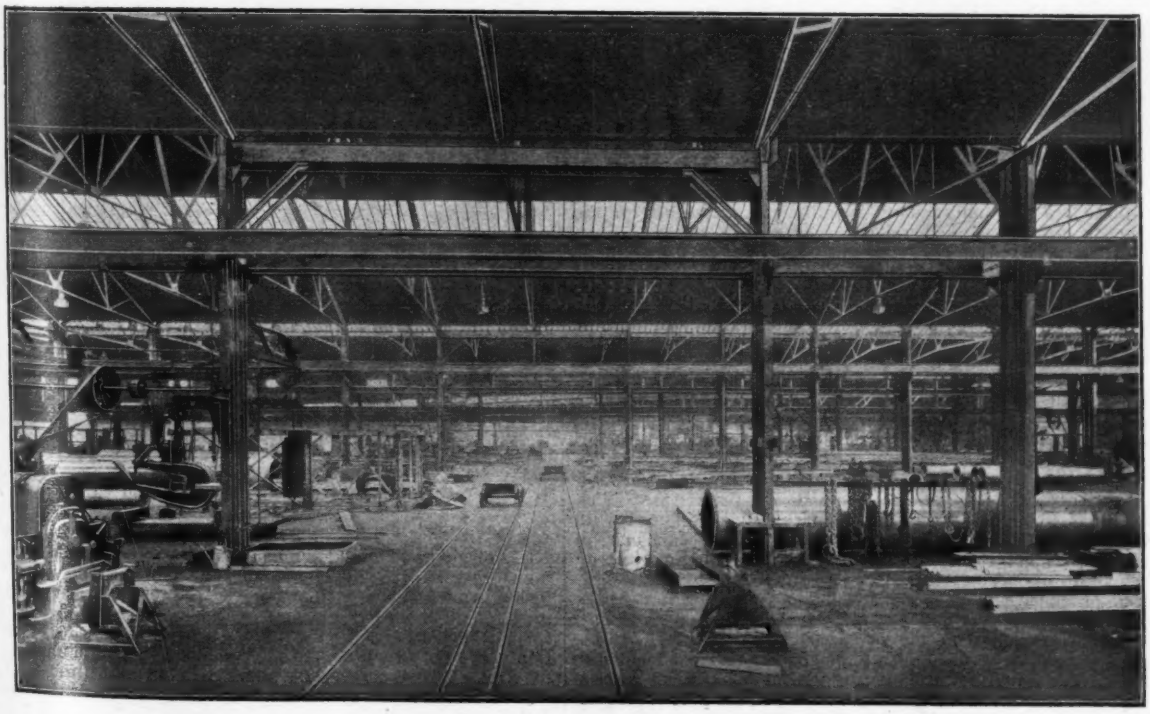
Plates, after marking out, are taken to the shears for cutting and to the rolls for straightening. Two guillotine shears are worthy of special note. These are exceptionally powerful machines, each capable of shearing plates 6 ft. wide and up to ⅝ in. thick in one stroke. These tools contribute a great deal to expeditious work of a high grade. Flanging presses, oxy-petrol and oxy-acetylene burners, and welding plant are very necessary portions of a modern structural department. The recently introduced oxy-petrol burner is worth some special mention on account of its great convenience and portability; the latter rendering it of

No. 3 Erecting Shop and Progress Stores.

considerable service in alteration work on gas-works in cases where an existing structure has to be cut for the reception of a new installation.

Nearly all structural steelwork of a complicated character must be erected and temporarily "tacked" together in the works before sending to the site. By this means errors are eliminated and time saved on the job. Therefore the large area, under cover, provided in these shops will be particularly noted. Raw material, in the shape of plates and rolled-steel sections of all varieties, is brought directly within the sphere of action of one or other of the overhead cranes and placed into store, care being taken to sort the materials so that unnecessary re-handling is avoided.

Another important operation in the structural steel department is that of drilling. Millions of holes being required to be made,



GENERAL VIEW OF STRUCTURAL STEEL SHOPS IN FOUR BAYS.

efficient drilling machinery is a very necessary part of the equipment of such a department as this. The principal battery consists of Asquith high-speed drills, arranged in such a manner that a long girder can be worked simultaneously by all four machines. The department is also very fully provided with machines for punching and shearing, straightening bars, and angle rolling.

The mechanical riveting of gas-mains calls for a special type of wide gap portable machine. These are actuated by compressed air. The riveting of girder work is more generally done by the pneumatic hammer type of machine—or "pom-pom" as it is called in the shops. The compressed air for this machinery is provided by one of the West air compressors originally designed for retort charging and drawing machines. The compressor actu-

Another View in the Structural Steel Department.

ally seen working on the occasion of the visit is a steam-driven machine altered for electric drive; and the apparatus for starting and stopping automatically to meet the demands of the shops was noted with interest.

The hydraulic plant for the supply of the flanging and other presses consists of duplicate electrically-driven pumps and accumulator. The supply of pressure water, return water, compressed air, and electricity to all parts of these extensive shops requires a great complication of pipe lines. The several services are indicated by the painting of the pipes in distinctive colours, in addition to which drawings of the whole arrangement are annually brought up to date.

Administration.

The works administration commences with the definite allocation of all work-hours to a distinct and fixed order-number. This is achieved by the "International Time-Recording System," in which every operation is represented by a card on which the time expended by every man is automatically recorded by a clock. Several of these clocks, with the accompanying cards and card-racks, are installed in the various departments of the works. The personal administration of the works is vested in a Works Manager, who is responsible to the General Manager for the whole of the works operations; under him there are two assistant works managers in charge respectively of the machine and fitting department and of the structural steel department. Under each of these are foremen and under-foremen responsible for the several sub-divisions of each department.

Technical Administration and Office Organization.

In view of the extent of the engineering work undertaken by the Company in addition to the manufacturing of iron and steel machinery and structures, it is not surprising that the drawing office occupies the whole of the first floor of the office buildings. There are actually two drafting rooms, one of which is devoted to the contract work. Here the whole of the drawings, quantities, erector's instructions, and other technical information in connection with contracts is issued to the works, to sub-contractors' works, and to the site. The drawings are made in ink on tracing cloth; the original drawing thus forming a negative from which prints can be issued as required, while the original itself is always retained in the stores for future reference and further use. The print room, which is located in this department, is equipped with two sets of blue-printing machines and a true-to-scale masse-lithographic apparatus. By means of the latter any number of black and white prints, equal in all respects to inked-in drawings, can be produced from one tracing and on any kind of paper—mounted paper for permanent records, thin copies for various purposes, or even tracing cloth from which other prints can be made. The print room is also equipped with a dark-room and photographic printing apparatus for the manufacture of lantern slides, for which there is a growing demand on the part of schools and lecturers in all parts of the world.

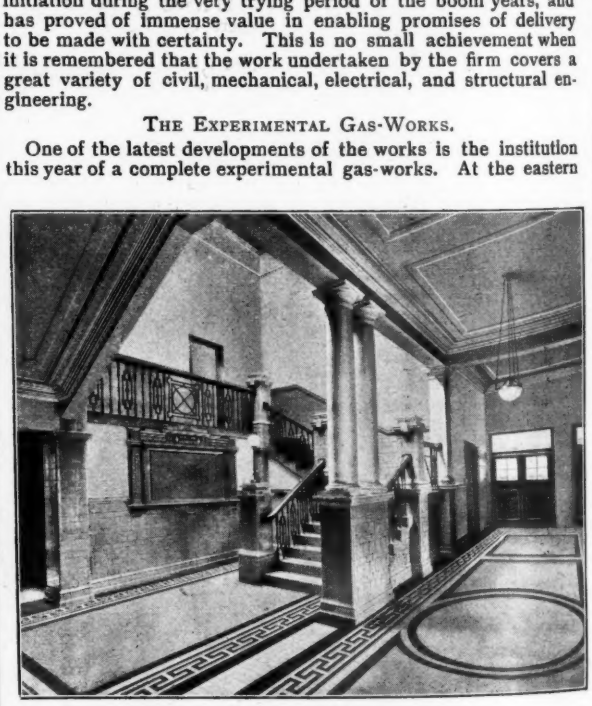
The other drafting room is occupied by the estimates department. Here schemes for new proposals are prepared, together with estimated quantities of materials of all kinds for pricing by the estimates department of the general administration. In this room, too, the spare-gear department is located, with elaborate reference records for the supply of spare parts to all the installations of new and old plant and machinery reaching back to 1884. Adjoining this room is the drawing stores, in which some 35 000 drawings are kept in numbered drawers. These constitute details of 40 years' working, enabling any part to be studied and replaced as required. These valuable records are issued only to certain authorized leading draughtsmen; and each drawing is booked out to the borrower on a card system. Thus track is kept of every drawing, and the percentage of losses is reduced to the minimum. The store is very fully indexed under cross references, so that it is comparatively easy to find any particular drawing. Between the two drafting rooms are the offices of the Engineer and his assistants and the typing room. The magnitude of the business may be judged by the fact that six typewriters are kept continuously busy on the issue of technical information alone.

Very careful attention is given to the estimates upon which tenders are based. For every proposal, great or small, sheets of estimated quantities are prepared in the engineering department. These quantities are then taken in hand by the estimated-cost department, where each item is priced for raw material, labour, and all other charges. An elaborate system of loose-leaf reference books is kept up-to-date, so that varying prices may be watched and an absolutely accurate estimate made. The sheets are also used for the recording of actual costs of production, an arrangement which was much appreciated during the period, now happily at an end, when contracts had to be executed on a sliding-scale basis. Gas undertakings were able to send down their accountants, who found ready to their hand a complete record of the cost of every portion of the work down to the smallest detail.

The re-organization of the output of the works and supplies from outside sources was one of the fruits of war-time experience. A new department was set up, whose duty it is to programme ahead the dates for completion of all operations of the multifarious work involved in contracts great and small, to advise all departments of the works and all suppliers of materials finished and unfinished by what date every portion of the work must be completed in order to fulfil the conditions of the contract, to see that all necessary technical information, drawings, instructions, &c., reach them in due time, and to advise the management when any department is reaching the limit of its capacity. The "Production Department" has fully justified its initiation during the very trying period of the boom years, and has proved of immense value in enabling promises of delivery to be made with certainty. This is no small achievement when it is remembered that the work undertaken by the firm covers a great variety of civil, mechanical, electrical, and structural engineering.

The Experimental Gas-Works.

One of the latest developments of the works is the institution this year of a complete experimental gas-works. At the eastern



The Entrance Hall—Showing the War Memorial.

end of the works, adjacent to the railway, a retort-setting with coal breaking and handling plant and all the usual accessories of a gas-works, in the shape of condensing and purifying plant, has been installed. The setting has been so fitted that new developments of all kinds can be tested on the premises before offering them to the industry. The setting will generally be heated by a portion of the gas manufactured, though arrangements are also made for the testing of coke producers as required from time to time. The surplus gas will be utilized for lighting and heating in the works. This installation will provide facilities for the testing of coals; and it is confidently anticipated that the industry will make full use of it when proposals are before them for carbonizing plant.

Activities—At Home and Abroad.

The late Mr. John West was so well known in the gas industry that his advice was sought in connection with many projects for gas-works constructions. In addition, therefore, to the manufacture, in the early days of the Company, of stoking machinery and the coal and coke handling plant in connection therewith, much of the work of the Company consisted in the preparation of plans for the reconstruction of complete installations of gas-making plant. At the present time the Company's activities in this direction are world-wide in their scope; and branch offices and subsidiary and allied companies have been established in the principal countries of the world. In the United Kingdom, a London office is located in a central position in Kingsway, where business in the Metropolis and the Home Counties is conducted and foreign visitors are received. The country generally is

Contracts Department of the Drawing Office.

divided between Resident Engineers in the South-West, in the Midland counties, in Scotland, and in Ireland, while the North of England is controlled by Engineers operating from the head office.

In the United States of America a subsidiary Company, the West Gas Improvement Company of America (Incorporated), operates from its headquarters in New York, from which a staff of engineers also represents the interests of the parent Company in Canada. Australia is provided for by the establishment of a branch office with a registered address in Sydney, N.S.W. Continental business in France, Italy, Spain, and Portugal is dealt with by arrangement with the Compagnie Générale de Construction des Fours, Paris; while Scandinavian clients are visited by an engineer-representative resident in Copenhagen. Working arrangements are also made from time to time for dealing with business in South America, China, Japan, South Africa, and other parts of the world.

The book then proceeds to sketch the development, between 1884 and 1908, of the West charging and discharging machinery for horizontal retorts. The scoop compressed-air machine proved a really practical solution of the retort-charging problem; and the same power source was applied to the discharging rake. The first combined machine made its appearance in 1903; and later the rake gave way to the semi-rigid chain and telescopic ram discharger. Then came the "pusher" single-stroke charger and discharger; and about the same time the West's projector was evolved. Altogether the firm's stoking machinery has been installed in upwards of sixty retort houses in this country and abroad.

Coal-handling plants receive a notice, for mechanical handling with breakdown risks reduced to the minimum has always been given the closest study by West's. The Norwich works of the British Gas Light Company are cited as providing an early example of a fixed-bucket elevator with band conveyor. Here the coal is raised direct from wherries in the river, the elevator being adjustable vertically to allow for the use of the boat as unloading proceeds and for lifting clear of passing vessels when not in use. Early in the present century, however, were recognized the advantages of the gravity bucket conveyor combining in the same apparatus, as it does, the elevator and conveyor with the fact that the material handled can be brought down and elevated simultaneously at different points of the system. The lip-bucket conveyor, which has received frequent notice in our columns, was brought to the front, and the need no longer existed for the mechanical filler.

Many of our readers may be unaware that the Derbyshire Silica Firebrick Company, Ltd., was an offshoot of West's Gas Improvement Company. It was founded by the late Mr. John West in 1892, to provide materials of the highest refractoriness for retort-settings. The Friden product is well-known.

Vertical Retorts.

Thus we arrive at the closing subject of a most interesting history. The greater proportion of to-day's business of West's Gas Improvement Company consists in the carrying-out in all detail of contracts for the installation of the Glover-West system of continuous carbonization in vertical retorts. The first installation of Glover-West verticals was erected at the St. Helens Corporation Gas-Works. Exhaustive experiments were carried out in this plant in collaboration with Mr. Samuel Glover, M.Inst.C.E., and subsequently two further large installations were brought into operation at St. Helens.

Estimates Department of the Drawing Office.

The principles and details of the system are fully described in technical publications issued from time to time; and in this connection it may be remarked that no trouble or expense has been spared in keeping the gas industry informed of the developments and the results obtained in all the principal installations erected. Since the introduction of the system in 1907, 132 installations, comprising over 5000 retorts, have been put into operation in most of the principal gas-works at home and abroad.

There follow thirteen perfect photographs of recent Glover-West installations, with brief notes respecting them. The souvenir book was described last week; but we may add that its 58 pages contain 53 photographs which merit a separate word of praise.

THE MAXIMUM LOAD ON ROLLER AXLES OF A SPIRALLY-GUIDED GASHOLDER.

By A. Gadd.

In dealing with the problem of gas storage, it has long been the custom of the designer to make use of concise formulæ for the purpose of determining the requisite strengths of the various parts of ordinary guide-frame holders; but it cannot be said that compact formulæ relating to the spirally-guided type have been largely published.

The following investigations into the maximum axle-load of a holder of the last-named character are submitted, not only on account of what are considered to be their interesting results, but because the latter will probably enable the necessary calculations involved to be readily made with a minimum expenditure of time.

In fig. 1 the rectangular outline may be considered to be a vertical section, in diagram form, through the centre of a single-lift, or, alternatively, through the mean dimensions of a multiple-lift, holder, and of the spirally-guided type; D being the diameter in feet, or mean diameter, as the case may be, and H the exposed height in feet above the top curb of the tank. The base circumference of the said exposed part, and of diameter x, $x = D$, is indicated in perspective by broken curved lines.

The holder is assumed to be fully elevated; and the conditions that it is in reality laterally supported by rollers in a plane somewhat above the level of the circle last referred to, and contact between rollers and rails occurs at some slight distance from the sheeting, are ignored. That is to say, in order to attain convenient approximations without introducing detail corrections of minor

importance, the holder is assumed to be held laterally at the ring of which x, x is a diameter.

W is the resultant of the wind pressure on the sheeting of the holder, and S is the resultant due to snow pressure on the crown,

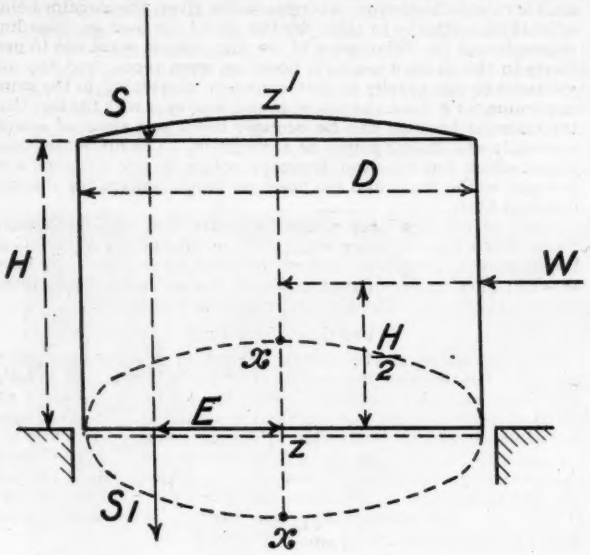


Fig. 1.

but usually assumed to be distributed over the circular plane projection of such crown. These two forces tend to tilt the holder about the diameter x, x.

z, z^1 is an imaginary line through the axis of the holder, and resultant W brought to this line, as indicated, provides the well-known tilting moment $W \times \frac{H}{2}$. Likewise, S brought down to position S_1 provides a tilting moment equal to $S_1 \times E$, or $S \times E$. Both these moments are here anti-clockwise in direction; and the first of them, for a wind pressure of 32 lbs. per sq. ft., or practically 16 lbs. effective on the cylindrical surface, takes the familiar form of $8H^2D$.

E is usually given the approximate value $\frac{D}{3}$, that being very nearly the position of the resultant of snow pressure distributed over a sector of one-quarter of the circular area assumed; so that for snow at 5 lbs. per sq. ft., the moment $S \times E$ takes the equally familiar form $0{\cdot}981\ D^2 \times \frac{D}{3}$, or practically $\frac{D^3}{3}$. In using formulæ, however, it is well not to lose sight of the various approximations assumed in building-up the same.

The sum of the moments referred to, or $D\left(8H^2 + \frac{D^2}{3}\right)$ must be resisted by vertical reactions at contact points of rollers and guide rails.

Fig. 2 shows a plan view of the base circle indicated in perspective in fig. 1; the diameter x, x being repeated. The holder

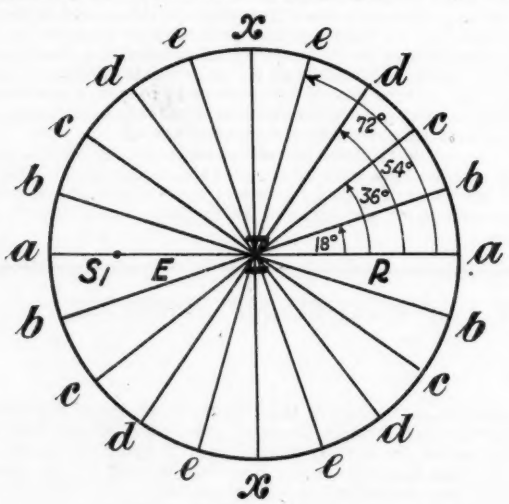


Fig. 2.

is assumed to be laterally supported by twenty pairs of rollers engaging a corresponding number of guide-rails on the structure. Theoretically the points of support are reduced to points on the circle indicated; and it is obvious that, to resist the tilting tendency already mentioned, the vertical reactions on the right of diameter x, x will require to be in the downward direction, and those to the left of the said diameter to be in the upward direction. It is obvious that, but for direction, the vertical reactions here called a, a are alike in value; and similarly those marked b are equal in value. Thus the reactions total up to $2a + 4b + 4c$ + &c. If those on the left of diameter x, x, in fig. 2, were changed in direction and transferred to corresponding positions on the right of the said diameter, the total resistance to the applied tilting moment would remain unaltered. Further, no change in result would be incurred by bringing down, parallel to diameter x, x, all the reactions concerned, so as to be concentrated along a radius perpendicular to x, x. This has been indicated in fig. 3.

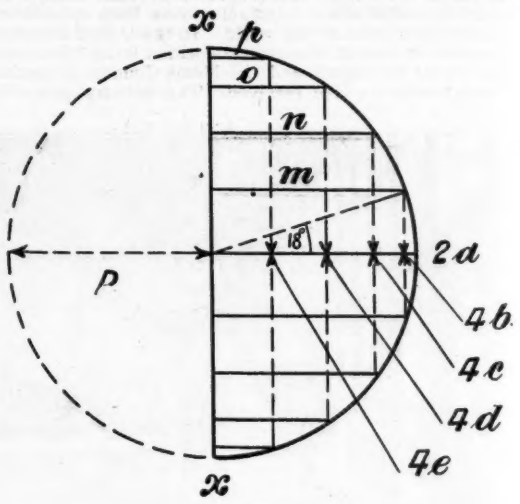


Fig. 3.

In fig. 4 the conditions of fig. 3 are shown in elevation—that is to say, z, z^1 is the vertical axis of fig. 1, line za, z is the radius upon which the reactions are concentrated, as shown.

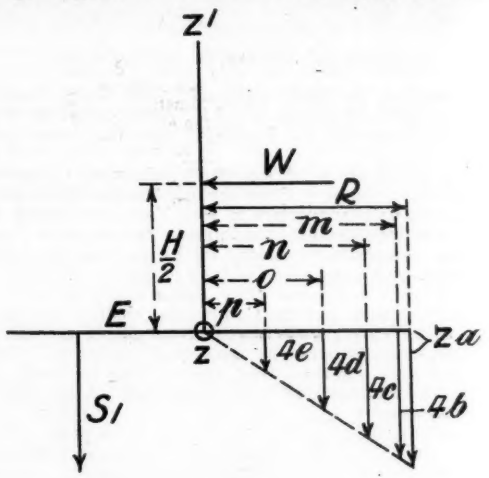


Fig. 4.

For greater clearness, reactions F, F_1, F_2, &c., will be substituted for the values $2a$, $4b$, $4c$, &c. (fig. 5). These reactions are developed

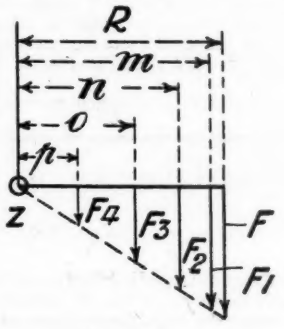


Fig. 5.

naturally when the wind and snow pressures act upon the holder; and the relative values of such reactions depend upon the respective distances from the centre z, after the manner of induced stresses in a cantilever subjected to bending moments. In other words,

$$\frac{F_1}{F} = \frac{m}{R}$$ (R being radius of holder), or $F_1 = \frac{Fm}{R}$

and the moment $F_1 \times m$ therefore equals $\frac{Fm^2}{R}$.

Similarly for the other reactions; and as F × R, for the sake of uniformity, may be written as $\frac{FR^2}{R}$, the sum of the moments of the reactions about centre z may be written as

$$\frac{FR^2}{R} + \frac{Fm^2}{R} + \frac{Fn^2}{R} + \frac{Fo^2}{R} + \frac{Fp^2}{R},$$

in which $\frac{F}{R}$ is a common factor.

But reference to fig. 2 will indicate that each of the angles subtended at the centre z of the circle is equal to 18°, or to $\frac{360°}{N}$ where N is the number of reactions, or number of pairs of rollers or roller axles. It is also obvious that $m = R \cos 18°$, $n = R \cos 36°$, and so on (fig. 3).

Substitution of suchlike values makes the sum of the reaction moments read:

$$\frac{F}{R}(R^2 + R^2 \cos^2 18° + R^2 \cos^2 36° + R^2 \cos^2 54° + R^2 \cos^2 72°)$$

in which the last angle, or 72°, is equal to 90°−18°, or 90°−(the first angle). R^2 being a common factor, the above simplifies to:

$$FR(1 + \cos^2 18 + \cos^2 36 + \cos^2 54 + \cos^2 72)$$

or to F R (unity + sum of squares of cosines).

The sum of the reaction moments equals the tilting moment due to wind and snow pressures; and as D = 2R, solving for F, we get:

$$\frac{2R\left(8H^2 + \frac{D^2}{3}\right)}{R \text{ (unity + sum of squares of cosines)}} = F \text{ in lbs.}$$

But F = 2a. Therefore (after cancelling R),

$$\frac{8H^2 + \frac{D^2}{3}}{(1 + \cos^2 18 + \cos^2 36 + \cos^2 54 + \cos^2 72)} = \text{reaction } a \text{ in lbs.}$$

The form of the denominator in the above equation (the terms in which depend upon the number of reactions or pairs of rollers employed) is not convenient for valuation, and even on squaring the various cosines exact results would not be obtained, because of want of finality in number of decimal points made use of; but a process of summation enables the desirable exactness to be secured with little effort.

Apart from the unity involved, the sum of the squares of cosines of angles which are in arithmetical progression as indicated appears to be derived from the expression:

$$\frac{t}{2} + \frac{\frac{1}{2}(\cos(t+1)\,A° \times \sin(t)\,A°)}{\sin A°}$$

in which t represents the number of terms in the expression dealt with, and here 4, and A is the first angle in degrees, and here 18°. In using the formula regard must be had to the possible negative values of the ratios involved.

After summation, unity has to be added to give the full value of denominator in the fraction in question. The following results have thus been calculated: N representing, as before, the number of reactions, or numbers of pairs of rollers or axles, where pairs are employed.

For N	= 12	the denominator	= 2
"	= 16	"	= 2·5
"	= 20	"	= 3
"	= 24	"	= 3·5
"	= 28	"	= 4

These values could be directly employed to suit individual cases; and it is to be noticed that they follow an equation to the straight line, and not to a curve, relatively to N. This fact indicates that:

$$\frac{N+4}{8} = \text{the denominator, in the examples named.}$$

The fraction in the equation for giving the maximum load or reaction a may be modified by substituting the last result for the denominator, so that, after dividing by 2240, the equation takes the final form:

$$\frac{H^2(24 + k^2)}{840\,(N+4)} = \text{reaction, or load } a \text{ in tons, in which } k = \frac{D}{H}.$$

This maximum vertical load may be considered to be transmitted partly as a distributed load on to the axle on account of the bearing surface of its roller, and partly as a direct load, because of its application at the central line of the roller groove. For practical purposes, it may be taken to be a point load applied at the outer-end part of the roller axle at the position of the groove referred to. Under such conditions, the usual stress and deflection formulæ may be readily employed for determining the diameter of the axle.

The example considered is one in which the centre of wind pressure lies on a vertical line passing through a reaction, but with the centre of pressure on a line passing between two reactions, or between sets of rollers, the effect is to introduce 4a, instead of 2a reactions at the extreme points of application—which latter are not much different, in distance from the centre of the holder, to the outer end of a radius. Therefore, as a matter of choice, the condition already made use of is to be preferred on the side of safety.

THE POSITION OF GAS IN CANADA.

By CANADIAN.

THE world's greatest electric power development under public ownership is in Canada. In the Provinces of Ontario and Manitoba, millions of pounds have been spent in harnessing waterfalls and distributing electric power to municipalities, even at great distances from the generating plants. Current for electric cooking and water heating is sold at many centres of population for ½d. per unit, less 10 p.ct. for prompt payment of accounts, making it a severe competitor of gas. At Ottawa, Ontario, the cooking and water-heating rate is only ½d. per unit. Gas companies in the United States have no such competition to meet, as the rates for electricity have in only one or two instances ever gone below 1½d. per unit; so naturally the gas undertakings have little to fear.

Even in the face of such severe competition, it is pleasing to report that many of the Canadian gas companies and municipally operated gas utilities are holding their own, and, in a number of cases, actually increasing their sales.

The long-continued strikes of the miners in the United States, and the severe transportation disturbance due to the strike of railway employees in that country in 1922, resulted in greatly increased manufacturing costs for every gas utility; and gas rates have of necessity been maintained at levels far above pre-war figures, but are now being gradually reduced. That Canadian gas utilities have been able to hold their business in the face of ridiculously low rates for electric current and increasing coal and labour costs, is a tribute to the engineers and managers, who are fighting a battle against great odds. Fortunately, there is evidence that the situation from the gas man's standpoint will improve, as various municipalities are finding the electric cooking and water-heating load a losing department of their business.

The hydro generating plants of Ontario are under the control of the Hydro Electric Power Commission of Ontario, a body appointed by the Legislature of the province. They finance all expenditures on the development of hydro electric plants and the distribution of the energy throughout the province up to the municipal corporate limits, by issuing bonds guaranteed by the province; the latter, in turn, receiving bonds from the municipalities interested in the development to serve their particular district. The Hydro Commission have arbitrary power to fix local rates for the various classes of purchasers of electricity, and from year to year adjust prices to meet local financial requirements and their own needs for operating expenses, interest, and sinking fund on the generating and transmission systems. In short, they are wholesalers, selling blocks of power to several hundred local commissions operating in municipal areas, but with power also to fix retail prices. Being able to raise money at low rates of interest by reason of the Provincial Bond guarantee, and having a large staff of competent engineers in their employ, they have proceeded with immense developments at Niagara Falls and other points where large water powers are available; and the municipalities of the province have benefited by obtaining electricity at the lowest possible prices.

The local commissions in each municipality report to the provincial commission, and the latter annually set the rates at which electricity shall be sold locally for various purposes. Naturally, the provincial commission are interested in building up a power load which will absorb their capacity to produce at the numerous generating stations; and this has led them to cast an envious eye on the cooking and water-heating business, so strongly held by gas utilities. To attract customers, the rates for cooking and water heating have been set at figures which are causing the local municipalities much concern, as they pay the Provincial Hydro for power on a basis of a twenty minutes' peak during each month; and any additional local load at peak hours runs up their monthly bills considerably. This is very nice for the Provincial Hydro Commission, as they receive payment for a whole month on the highest peak supplied to local municipalities, and, as all local peaks do not synchronize, are receiving payment for a great deal more than the actual total power they deliver.

The local commissions suffer considerable losses if they have developed an extensive cooking and water-heating load at the low rates prevailing, by reason of this load being superimposed on their regular peak load at certain hours of the day, such as 11.30 a.m. and 5.30 p.m. One Ontario Municipal Hydro Commission recently investigated their cooking load, and discovered that their revenue from it amounted approximately to $33.00 per H.P., whereas they were paying the Provincial Hydro, owing to the twenty-minute peak load basis of settlement, $61.00 per H.P. for power required to serve their customers using electricity for cooking. Several other local commissions are investigating the same matter; and there is every reason to believe that they will bring pressure to bear upon the Provincial Hydro to adjust the rates in order that the cooking load shall not prove disastrous to their financial position, as it undoubtedly will if they continue to sell current at losing rates. The object of the great hydro development in Ontario was to give service at cost, and it has proved eminently successful in reducing costs for power, commercial and industrial lighting, and industrial services. But these are being asked to bear the heavy losses on the cooking load under present conditions; and this position will not be allowed to continue

without protest. Other factors which serve to increase the cost of the cooking load are the necessity of enlarging feed wiring, increasing size of transformers, sub-stations, &c.

When the hydro domestic rates were set some years ago, the basis of charge was a definite fixed sum per consumer per month, figured from the area of the floor space in his house, *plus* a charge for actual current used. Cooking and other auxiliary services were not important in those days, and the "space rate" applied fairly; but now that electric cooking and water heating are being so strongly advocated, one man may require a maximum of 5 or more H.P. capacity, whereas his neighbour, still using gas for cooking, only needs a maximum of ½ H.P., yet both may pay the same fixed charge under present ratings. What will be urged is that the connected load of appliances other than lighting fixtures be ascertained, and a definite monthly charge per horse power of possible demand be imposed. As power users are charged approximately 3s. 8½d. per H.P. of connected load as a monthly fixed charge, it would appear reasonable that cookers, water heaters, &c., should pay upon the same basis.

If this basis is applied, or rates to cover cost of service are fairly adjusted, the charge for electricity for domestic service other than lighting will be materially increased, to the decided advantage of the gas utilities. It is not equitable that one class of consumer should obtain service at less than cost at the expense of others; and there is every probability that the agitation for adjustment of electric rates will result in gas utilities being relieved of the unfair and uneconomic competition they have suffered during recent years.

CONSIDERATIONS RELATING TO THE FUTURE OF SULPHATE OF AMMONIA.

By R. C. Taylor, B.Sc. (Gas.Eng.), of Bridlington.

[A Paper read before the North of England Gas Managers' Association, Sept. 21, 1923.]

The development of processes for the fixation of atmospheric nitrogen received an enormous impulse under the stress of war conditions. All the countries engaged in war invested large sums of money in these processes, thereby tending to relieve the carbonization industries of any control of nitrogen fertilizers—a control which, with the diminution of the beds of Chilean nitrate, appeared quite probable. One thing, however, is certain: Bye-product ammonia always stands out as an article which must be produced; and there is no price so low as to stop its production, a factor which the synthetic processes will always have to take into account in the open market.

The bulk of the nitrogen recovered from the carbonization of coal is fixed by means of sulphuric acid. The latter is costly; and the sulphate radicle, besides being practically useless for manurial purposes, presents the agriculturist with the additional expense of maintaining a non-acidic soil so essential to the growth of crops. Generally speaking, a ton of lime is required to neutralize the acidity due to four tons of ammonium sulphate. In view of these facts and of the very considerable competition likely to arise in the near future from the high-percentage synthetic nitrogen products, it would appear that other means of fixing gas-works ammonia will have to be used if this product is to be in the future the profitable source of revenue it has been in the past.

To consider briefly the processes now in use for the utilization of atmospheric nitrogen, they may roughly be divided into three classes:

1. Conversion of nitrogen into nitric or nitrous acids.
2. Conversion of atmospheric nitrogen into compounds that readily yield ammonia.
3. Direct synthesis of ammonia.

As yet it is too early to form any definite opinion as to which methods will prove the most satisfactory. The first group is at the moment restricted solely to countries where power costs are abnormally low. Several processes are at present in successful technical operation involving the direct combination of atmospheric nitrogen and oxygen by the heat of the electric arc, and the absorption of the resulting oxides of nitrogen in water or alkalies. These processes require much improvement. Owing to faulty furnace design, a large proportion of the air cannot possibly come in contact with the arc; and this results in a low electro-chemical efficiency. Again, owing to the dilution of the oxides of nitrogen, an extensive and costly absorption plant is essential. The large power requirements will be better realized when it is stated that only between 3 and 4 p.ct. of the electrical energy supplied is ultimately used in the actual union of nitrogen and oxygen, although a considerable proportion of the heat is carried away as sensible heat by the furnace gases and utilized for steam raising. As regards the final product, either ammonium nitrate or nitrate of lime is made. Both these salts, however, are of a highly hygroscopic nature, which retards their spreading qualities. This has been somewhat overcome by admixture with bone-meal, which it was also hoped would destroy the explosive properties of the ammonium nitrate. In view of what happened at Oppau, the non-explosive fertilizer form of ammonium nitrate must be regarded with suspicion. Owing to power costs, it does not appear likely that this process will hold great sway in this country.

The processes that produce compounds which readily yield ammonia are, apart from the manufacture of nitrolim (calcium cyanamide), very much in the experimental stage. They are based on the fact that most metals, and many non-metals, combine more or less readily with nitrogen to form nitrides, from most of which the nitrogen can be obtained in the form of ammonia by treatment with water or alkalies. Calcium cyanamide is obtained by the treatment of finely-ground calcium carbide with nitrogen at an elevated temperature; the nitrogen being usually separated from the atmosphere by one or other of the air-liquefaction processes. This method, compared with the arc process, uses per unit of nitrogen fixed about one quarter of the power; and a solid nitrogenous compound is formed which can be used directly as a fertilizer, thus avoiding conversion costs, as incurred in the case of the other synthetic processes comprising the conversion of liquids into solid marketable forms. Cyanamide does, however, suffer from the disadvantage that it is both dusty and corrosive. The trouble is attributed to the presence of free lime and unchanged calcium carbide. Many efforts have been made to overcome these difficulties; and about two years ago the Prussian Ministry of Agriculture offered a large prize for the best suggestion, but none was considered wholly satisfactory. Another disadvantage attending the use of cyanamide is that, in presence of alkali, there is produced when the fertilizer becomes moist a certain proportion of dicyanodiamide; and unfortunately this substance is toxic to plants, and produces characteristic white tips to the plant life under cultivation. Of course, these difficulties might be obviated by treating the cyanamide with steam in an autoclave, and thus liberating ammonia and fixing it by other methods.

Synthesis of Ammonia.

The last group, and probably the one to be most successful, is the direct synthesis of ammonia from atmospheric nitrogen and hydrogen. The early work in connection with this process was done by Haber and his pupils, who investigated the equilibrium at different temperatures and pressures in the reaction

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The union of nitrogen and hydrogen to ammonia is an exothermic reaction, and, at ordinary temperature, is accompanied by an evolution of 11,890 calories per gr.-mol. of NH_3. Therefore a low temperature would favour its production; but the velocity with which the state of equilibrium is reached decreases with decreasing temperature, so that a suitable catalyst must be used to attain equilibrium at low temperature. Also, as the combination of nitrogen and hydrogen to ammonia is accompanied by a decrease of pressure at constant volume, increase of pressure will increase the concentration of ammonia at equilibrium for a given temperature. Haber, with the co-operation of the Badische Anilin- und Soda-Fabrik, devised a process which gave, despite the great practical engineering difficulties due to circulation of gases under many atmospheres pressure (between 200 and 100) over a catalyst at 550° C., excellent results. In essence, the process consists of the production of hydrogen and nitrogen; about 77,000 c.ft. of hydrogen and 26,000 c.ft. of nitrogen being required for the production of a metric ton of ammonia.

The production of hydrogen as employed at Oppau is from water gas. The latter is passed, together with steam, over a catalyst at a temperature of between 400° and 500° C. Thus, with this excess of steam, the reaction

$$CO + H_2O \rightleftharpoons H_2 + CO_2$$

is disturbed in favour of the production of CO_2 and H_2, and we get an average gas issuing from the catalyst chamber, when fixed from excess steam by cooling, of the following composition:

H_2 = 65 p.ct. CO = 1 to 2 p.ct. CO_2 = 30 p.ct.
N_2, CH_4, &c. = 4 p.ct.

The gases are compressed to about 25 to 50 atmospheres, and are freed from CO_2 by counter-current scrubbing with water while under pressure, with a final washing of alkali solution. Taking into consideration the fact that each volume of water gas produces approximately its own volume of hydrogen, it would appear to be a very cheap process; the nitrogen present not being a disadvantage. By the addition of air to the steam in the "make" period of the water-gas manufacture, any desired nitrogen-hydrogen mixture can be obtained. The power requirements are certainly the lowest of the other established methods of fixing nitrogen. It is estimated that Germany's capacity for fixing nitrogen in the form of synthetic NH_3 amounted to 300,000 tons in 1920. A process similar to the Haber method is working at the coke-ovens at Béthune under the direction of Claude. The coke-oven gas is relieved of its constituents other than hydrogen by cooling in three stages between −160° and −210° C. This hydrogen is then circulated over a catalyst at 900 atmospheres pressure, along with the products of combustion of a gas-engine using hydrogen as fuel. The plant is only in an experimental stage, having a production of 5 tons per day. It is claimed that this method is cheaper than the Haber process; the cost of production of hydrogen in the latter process being 65 to 70 p.ct. of that of the ammonia produced, compared with 45 to 50 p.ct. in the Claude.

Thus the fixation of nitrogen by any of the three methods—namely, as nitric oxide in the high tension arc, as cyanamide, and as synthetic ammonia—involves in each case two economic factors, power and material. On the predominance of the one or the other of these two will depend the practicability of any one of the processes under given geographical conditions; the arc process being therefore limited to countries producing cheap

hydro-electric power, while cyanamide is capable of production at the source either of cheap power or of the necessary raw materials. Synthetic ammonia, by virtue of its low power factor, is independent of geographical conditions provided the hydrogen be made from fuel.

Ammonia Fixation.

Having derived ammonia, the question of its fixation arises. Unquestionably, the ideal fixation would be by the combination with some nitrogen or phosphorus acids, for both these elements are essential constituents of plant foods. The process used at Oppau to fix the synthetic ammonia is quite well known in this country—namely, the oxidation of ammonia to form nitric acid, and from this the production of ammonium nitrate. This process is now widely used in this country for the production of oxides of nitrogen used in the oxidation of SO_2 to SO_3 in the manufacture of vitriol, and gives excellent results. In essence, the process consists of passing a mixture of air and ammonia over heated spongy platinum, which gives nitric oxide, in accordance with the following reaction.

$$4NH_3 + 5O_2 = 4NO + 6H_2O + 215{,}000 \text{ cals.}$$

The theoretical yield of nitric oxide is never obtained, probably due to the subsequent decomposition of the nitric oxide or the reaction between nitric oxide and ammonia. The plant used is very simple, consisting of a plant for generating the ammonia, and a blower for the necessary air supply. The catalyst is usually of platinum gauze; and the normal impurities in the ordinary commercial 25 p.ct. ammonia from gas-works has little or no effect on its activity. The mixture of air and ammonia is filtered through cotton or slag wool, passed between baffles to ensure thorough mixing, and then through the catalyst chamber. The catalyst is first electrically heated; and after a few hours working, by a system of heat exchange and the heat of the reaction, it is maintained at the required temperature without further external heating. The gases, after passing through the catalyst, are cooled and led up absorption towers; the air necessary to complete the oxidation of the nitric oxide to nitric acid being added here. Owing to the reduced activity of the platinum gauze through the sulphur compounds present in gas liquor, it has not been found possible to use this product direct, although it might be possible to find a suitable catalyst cheap enough to be discarded when its activity has been reduced below the economic limit for dealing directly with gas liquor.

Another means of fixing ammonia which has received much investigation on the continent is the conversion of ammonia into urea; and already much success has been achieved in this direction. A fertilizer known as "Phosphazote," which is a mixture of urea and superphosphate of lime, is produced by the Société des Produits Azotes in Switzerland, and has found continued application in the vineyards of France. Pure urea contains 46·7 p.ct. of nitrogen, and besides being a very concentrated manure, is not deliquescent, and, unlike ammonium nitrate, is non-explosive. The urea in phosphazote is, by the way, prepared from cyanamide; but, as a result of the work of C. Matignon, the Badische Company have patented a process whereby ammonium carbamate is first prepared by the interaction of carbon dioxide and ammonia; urea then being produced by the dehydration of the carbamate in an autoclave at a temperature of 145° C.

A certain amount of chloride of ammonia is now being produced as a fertilizer. Hydrochloric acid is made in such bulk in certain processes of manufacture that there is not sufficient outlet for it. But if chloride of ammonia is to be manufactured, it would depend almost entirely upon the cost of hydrochloric acid, as the chloride, like the sulphate, radicle is not of manurial value. It would, however, possess the qualification of containing 26·2 p.ct. of nitrogen when pure.

Fertilizers in Practice.

Now to consider the fertilizer from the agriculturists' point of view. Unquestionably the cost per unit of nitrogen is of primary importance; and thus, where carriage is an appreciable amount, a high percentage of nitrogen in the fertilizer will be a distinct asset. More particularly would this apply to export trade. The cost of distribution on the land is practically the same whatever the percentage may be, provided the fertilizer be in a fine friable condition. The choice of fertilizer is governed to a large extent by local conditions. The great majority of plants are unable to assimilate nitrogen in the free form in which it occurs in the atmosphere, but take it up from the soil in the shape of nitrates. Nitrogen in the form of ammonia is acted upon by the nitrifying bacteria in the soil, and is converted into nitrates. The speed at which this change occurs depends to a great extent upon temperature; hence in tropical regions the rapidity of change is very great. Thus, to apply nitrates to the soil in these regions would be a distinct disadvantage, owing to overgrowth in the initial stage of the plant life. Consequently ammonium salts or urea would hold a distinct advantage in these regions.

As a result of the new processes now in vogue for the production of nitrogen salts, extensive field trials on experimental stations have been made with these new and unfamiliar nitrogenous manures to ascertain whether they would give results comparable with those of the established manures. The first table gives the percentage of nitrogen contained in some of the salts.

Percentage of Nitrogen in Salts.

—	Pure.	95 P.Ct. Pure.
Nitrate of soda	16·5	15·7
Sulphate of ammonia	21·2	20·1
Nitrate of lime	14·0	13·3
Nitrate of ammonia	35·0	33·2
Chloride of ammonia	26·2	24·9
Calcium cyanamide	35·0	33·2
Urea	46·7	44·4

One of the series of tests made on these salts by the North of Scotland College of Agriculture was on oats and hay. A series of plots of like nature were equally manured, except No. 4, with 2 cwt. of superphosphates per acre, and 1½ cwt. of potash salts per acre in the case of oats, and 1 cwt. in the case of hay. The standard nitrogenous manuring was taken as 1 cwt. of sulphate of ammonia per acre; and all other plots were given the same amount of nitrogen per acre as is contained in 1 cwt. of sulphate of ammonia.

Field Experiments with Nitrogenous Manures.

Plot.	Nitrogenous Manure per Acre.	Oats.		Hay, Cwt. per Acre.
		Grain, Bushels of 42 Lbs. per Acre.	Straw, Cwt. per Acre.	
1	1½ cwt. calcium cyanamide.	89·5	44·9	60·3
2	¾ ,, chloride of ammonia	102·8	47·8	63·9
3	3·5th ,, nitrate of ammonia.	101·9	54·2	61·4
4	no manure	81·9	43·0	50·7
5	1 7-10th ,, nitrate of lime	93·3	44·2	67·1
6	no nitrogen	83·8	44·0	60·0
7	1½ ,, nitrate of soda	97·1	49·3	66·4
8	1 ,, sulphate of ammonia	93·3	49·0	64·3
9	2·5th ,, urea	95·2	47·1	65·2

These tests are shown because they constitute a fair average of the field trials made. It will be noticed that there is not any marked difference per unit of nitrogen; small differences in the reverse direction have been noticed in other field trials. Generally speaking, however, the fertilizers may be regarded as equal per unit of inorganic nitrogen.

The demand for fertilizers is increasing in this country and abroad. The marked effect of the use of sulphate of ammonia during the war period did a great deal to demonstrate to the farmer its enormous value, and the ease, compared with farmyard manure, with which it could be applied to the land. And it would appear that for several years at least, even when the fixation industries have brought down the cost of manufacture to an economic level, the demand for sulphate should not materially decrease, provided sulphuric acid approaches more closely to pre-war costs, and allows a cheaper product to be obtained. Nevertheless, it must be borne in mind that the future of sulphate of ammonia is by no means assured. The acidity due to its breakdown in the soil, the cost of distribution of a useless radicle—*i.e.*, the sulphate radicle, are factors bound to present themselves to the agriculturist when he compares this product with (say) urea, which contains about twice the percentage of nitrogen, with resulting reduction in the cost of carriage, particularly for export, and distribution on the land, and the absence of ill effects. Another point strongly in favour of the synthetic products is their purity—an essential in most catalytic processes.

The Pease Process.

The recently devised process—namely the Pease, for the dry extraction of ammonia by means of phosphoric acid—is certainly one step in a right direction; but it may be a little too early at the moment to vouch for its success. Apart from the economical aspect of the process, the fertilizer may contain cyanogen compounds toxic to plant life; whether this be so or not will remain to be seen. I do not know of any field trial made with this product up to date.

Owing to the fixation processes in Germany receiving government support, and to the fluctuation of the mark, a direct comparison of costs at the moment is entirely out of the question. Certainly Germany would appear to be intent on the fixation of nitrogen if only to safeguard herself in the event of future wars; and from this fact alone we may expect cheap products, if only to keep her plants in working condition.

I would therefore suggest to the members of this association the advisability of considering possible methods of converting gas liquor into compounds of the nature of urea, nitrate and phosphate of ammonia, &c., with a view to restoring the financial return from ammoniacal gas liquor which has fallen off so considerably and is so seriously threatened by the fixation processes.

Discussion.

The President congratulated the author upon providing a topical, as well as an interesting and suggestive paper. The great reduction in the financial return from gas liquor during the past few years, while in some respects conditions had been favourable to sulphate of ammonia, must exercise the minds of those responsible for dealing with the question. The prospect of even more serious competition from synthetic nitrogen products would be very unpleasing, or at any rate of doubtful pleasure, if the gas industry could only rely upon sulphate-making for the disposal of the liquor. He did not mean to imply that synthetic products were bound to dominate the position and destroy sulphate. Possibly, by forcing a reduction in the price of sulphuric acid and in other costs of manufacture, the effect might be very different; but the future was not completely assured. The capital

involved in synthetic nitrogen production must be enormous, and the output must be correspondingly great. While the fact that sulphate of ammonia was a mere bye-product of gas manufacture gave it a great advantage over any main product, it was by no means certain that it might not have to be manufactured at little or no profit. It was equally possible that the return on the enormous capital involved in synthetic nitrogen production might be so small as to restrict the growth of that business. Any proposition therefore providing alternative methods of utilization of ammoniacal liquor was well worth their close consideration. Mr. Taylor's paper almost seemed to imply that special products might be manufactured for specific regions, and that this might be done by the manufacture from gas liquor of products that up to the present were made by the fixation industries. If these suggestions were economically sound, it was to be hoped that they might bear fruit, and that some undertaking of the requisite magnitude might make a trial of them. The fact that, per unit of nitrogen, the results of all nitrogenous fertilizers were approximately equal, naturally suggested the idea that, given two fertilizers equally suitable in other respects, the one giving the cheaper unit of nitrogen was the one to manufacture in the common interest of producer and user. The technique of the processes described in the paper was of interest. He would suggest that Mr. Taylor might, on another occasion, compile a paper proposing the technique suitable to the new methods of dealing with gas liquor which he had put forward for consideration.

On the invitation of the President,

Mr. H. A. Pease, son of Mr. E. Lloyd-Pease (of Darlington), opened the discussion, and briefly described the process invented by his father for the production of "N. P. K." fertilizer. The process was still only in its infancy. Perhaps some of those present were not familiar with it. He reminded them that the process consisted in the mixing of the base material, saturated with crude phosphoric acid, which by being put into a vessel and rotated was made to fall in a cloud. Town gas, or other gas containing ammonia, on coming into contact with the material in this condition, formed ammonium phosphate, and they had in the vessel a complete fertilizer. In other words, it contained nitrogen and phosphorus, and, if so desired, potash. The potash could be added either in solution or pulverized and mixed in with the base. The method ensured the presence of the three essential plant foods in the proper proportions, which was very important. When it was considered that each minute rootlet of the plant must have access to each of the fertilizing ingredients—namely, nitrogen, phosphate, and potash—it would be realized they were at the beginning of a process whose commercial importance it would be very difficult to foretell. He concluded by expressing the hope that when they saw mention of the "N. P. K." process they would take a kindly interest in it, when perhaps mutual advantage would accrue.

Dr. Weyman said they were very much indebted to Mr. Taylor for his paper, and also to Mr. Pease for his additional information with regard to the "N. P. K." process. He took it that one of the chief values of the paper might be to encourage them to look a little wider afield than they had been doing, and to examine new processes with a view to seeing if they could adapt them to make more profits than from sulphate of ammonia. The author had mentioned in the first part of his paper that the ammonia from gas-works need not necessarily bear any cost; but he thought, if it was worked up at all, that ammonia should bear some proportion of the cost of the raw material from which it was derived—coal. That cost should be debited at the beginning rather than when the profit had been made. The question of competition with synthetic products he did not think would be a very serious matter in this country, from the fact that synthetic products were chiefly manufactured in Germany, where coal, especially lignite, was cheap. In some foreign countries where there was water-power, the cost of production might be lower than in England. At the same time, sulphate was a very convenient form of fertilizer. The manufacture of ammonium sulphate was comparatively very simple, and the product was easily handled; so that he thought they should consider sulphate of ammonia on its merits before they turned to other possible products. There was, it seemed to him, no possible outlet for ammonia from gas-works which had not been examined in this country, although favourable reports had been received from abroad, including Denmark and Germany, of the direct application of ammoniacal liquor to the soil. It was diluted and spread directly on the soil; and there had been reports of remarkable results. He thought that was a proposition which in the smaller works, favourably situated in country districts, where there was no manufacturing plant available, might be considered. It had been mentioned several times in the Press recently, and reported on favourably, he believed, by one of the German Institutions. The "N. P. K." product was, he thought, a question of cost—that was, whether it would be more profitable to make sulphate and mix it with potash and phosphates, or whether it would be better to prepare it by direct absorption from gas, as Mr. Pease had suggested. This was a proposition which would probably depend on working trials, which he understood were being carried out.

Mr. Pease, in reference to Dr. Weyman's remark concerning the matter of cost, said he would like to point out that in the ordinary mixture of fertilizers sulphate of ammonia was mixed with superphosphate. Both these required sulphuric acid for manufacture, with the result that in the fertilizer there was the sulphur radicle from both the ammonium sulphate and the calcium sulphate. Not only was the sulphur radicle undesirable on the land, but it could be distinctly harmful. In the manufacture of superphosphate, sulphuric acid was used in the making of the phosphoric acid, and the sulphur radicle remained in the superphosphate. If, therefore, the sulphate of ammonia were added, they would have additional sulphur radicles in the fertilizer, because, as would be seen, sulphuric acid had been used twice, although, as such, it was not required in the final product.

Mr. Taylor, with regard to Dr. Weyman's remark on his statement that (in regard to ammonia) "there was no price so low as to stop its production, a factor which the synthetic processes will always have to take into account in the open market," certainly agreed with him that it should bear a charge in proportion to the cost of coal. What he had implied was that they must get rid of the ammonia. The return from gas liquor might be low, or they might even have to pay to get rid of it. They certainly had to get rid of the liquor; but the cost of the distribution of gas liquor on the land, even if it were possible to show it was beneficial, was very heavy.

The President referred to an incident which had occurred in his own experience, in regard to gas liquor. They did not work it up, but tried to sell it. Towards the end of the war period they had to give it away—in fact, his Company had been asked to pay 8s. per ton in order to get rid of it; and when that time came, he put a proposition to the local farmers' Association offering to give it to them free. He obtained the promise of the loan of a spraying machine; and it had been stated in the Technical Press at the time that to spray dilute gas liquor on the growing corn did not injure it, though it was well known that to spray the liquor on plants had an injurious effect. It was stated it could be sprayed on various cereals without deleterious effect on the leaf or straw, and that it greatly improved the yield. When he put it to the local farmers, he was faced at once with the statement that the cost was too great. They said that if it had been a dry manure they might have put it in with what they called locally the "manishment," so distributing it without cost; but the cost of spraying would absolutely kill it. No one took advantage of his offer.

Dr. Weyman said he took it that the cost of the distribution would have exceeded the cost of solid manure.

The President replied that he could not say; but the cost deterred the farmers from making the attempt.

Dr. Weyman pointed out that it should, of course, be sprayed diluted, and put on the land before the crop was sown. It had a sterilizing effect on the soil, and that had to pass off before advantage could be derived from the manure.

The President said he had offered it to the farmers in the autumn.

Dr. Weyman said that was the advice given. It would be very valuable and interesting if they could sometimes get experiments carried out in the country. In moving a vote of thanks to Mr. Taylor, he said the writer had put before them suggestions which would cause them to think and look round, and broaden their views with regard to the manufacture of bye-products, some of their methods in dealing with which were so old-established that many might think there was no more to be learned. They had had a most interesting paper.

Mr. H. E. Copp, in seconding, said the technical fare provided that day had been of an exceptionally high order. Not only had the President's address been able, but it was, of course, extremely original. Mr. Taylor had stated the whole of the facts known on the subject of his paper up to the present time, though it was a pity he had not given them some idea of the cost of the manufacture of synthetic ammonia. In countries where there was unlimited water power, it might be a little cheaper; but it could not be manufactured much cheaper, owing to the vast capital that must be invested, because the electric power required for fixation of nitrogen was so great. One thing which had affected the consumption of sulphate of ammonia in the past was that it had been in a distinctly acid condition. This was now remedied, and neutral salt was made by most of them. Of course, it was very difficult to explain to the farmer not only how it should be applied, but to get him to realize also that he must not allow his land to become acid. Lime must be applied. There had been a good deal of prejudice against the use of this bye-product; but he thought they were beginning to realize its advantages. Mr. Copp referred to an experiment which his father, one of whose interests was farming, forty years ago (and beyond the scope of his own memory) had carried out on some land farmed by him. He applied sulphate of ammonia, spreading it over very poor grass land, and it made the latter positively superior to that of other farms in the neighbourhood. He did not think his father had been spared to try it on cereals; but it was recognized in the district that it had had a good effect on the pasture land to which it had been applied. He heartily seconded the resolution.

The President said during the war a farmer from the neighbouring district of Bempton had approached him with regard to sulphate, as he was finding difficulty in getting potash, &c. He told him he had a field of very bad land. Just before that the late Mr. John West, of respected memory, had read a paper in which he had described the results of using sulphate of ammonia on a farm which contained some of the worst land in Derbyshire. The result had proved most satisfactory, and the land, from being among the worst, was turned into some of the best land in the country. He had told the farmer of the case, and given him the technical papers written on the subject by Mr. West, and had emphasized that with sulphate of ammonia he must use sufficient lime to prevent the land becoming acid. He followed his advice, liming well, and putting on the sulphate of ammonia. The farmer had had to leave a corner of the field untreated. After he had harvested his crop he met him one day, and the farmer said to him: "You are the best farmer in the country round here." Many of the old neighbouring farmers who knew the land had gone periodically to look at it; and it had yielded a crop better than any land in the district. But the portion of the field which had not been treated had yielded as sparsely as it had ever done. He personally knew nothing about farming; but the case seemed to bear out what Mr. Copp had said in regard to the use of lime.

Mr. Taylor briefly acknowledged the resolution.

Society of British Gas Industries.—We learn from the Secretary (Mr. Arthur L. Griffith) that the Society have removed their offices to No. 56, Victoria Street, Westminster, S.W. 1. The telephone number is now Victoria 8948; and the telegraphic address, "Treforgan, Sowest, London."

Institution of Welding Engineers.—At a meeting of the Institution to be held at the Holborn Restaurant at 8 p.m. next Wednesday (Oct. 10), under the presidency of Sir W. Peter Rylands, J.P., two papers—one on Electric Welding and the other on Gas Welding—will be read. These papers are expected to present some novel features. Should any readers wish to obtain tickets of admission, they can be had on application to the Hon. Secretary, Mr. C. Raggett, of No. 30, Red Lion Square, W.C.

NATIONAL GAS EXHIBITION.

BINGLEY HALL, BIRMINGHAM, SEPT. 17—OCT. 3.

[An account of the Exhibits was published in the Special Number issued on Sept. 19.]

The promoters of the National Gas Exhibition are well satisfied with the all-round success that has attended the undertaking. On Friday last, the official estimate was that 50,000 persons had attended the exhibition, and it is true to say that this figure has since been increased by another 15,000 or 20,000. Many of the standholders are perfectly satisfied with the trading results. This remark applies particularly to the makers of gas equipment. Not only have many substantial orders been placed, but the number of inquiries has been exceptionally large.

Every day last week official visits to the exhibition were made by leading representatives of gas undertakings, gas committees, and boards of directors of companies from all parts of the country. The number of these was, indeed, very considerable; and there was a consensus of opinion that the exhibition was fully up to tradition. Gas committees and companies generally offered facilities to their employees to visit the exhibition; and it was encouraging to see fitters and inspectors, in large numbers, making a critical tour in the early part of each day, before the arrival of members of the public. In this way, much valuable technical information was gleaned. The visitors during the week included a further small contingent of French gas engineers, and gas managers and engineers from Holland and Switzerland. Members of the Walsall and Coventry Gas Committees attended on Thursday, the former being accompanied by the Mayor of Walsall; and on the same day a visit was paid by the Smethwick Gas Committee, and the Board (including the Chairman) of the Rugby Gas Company. Sir David Davis (Lord Mayor of Birmingham) and Alderman Williams (Lord Mayor Elect) accompanied the members of the Birmingham Gas Committee. Sir Dugald Clerk was an interested visitor on Friday. Saturday was an extremely busy day; and the afternoon witnessed the arrival of 250 of the employees of the Gas Light and Coke Company, with whom was Mr. Stephen Lacey. There were, too, scenes of great activity at Bingley Hall early this week; the official visits of the Council of the Institution of Gas Engineers and the Commercial Sections of the District Gas Associations being made on Monday.

The Birmingham Gas-Works have been inspected by many engineers, and for this week several such visits by parties were arranged. Last week, at the invitation of the Committee, official visits of inspection were made by the City Council of Birmingham and the chief officials; and upon them a most favourable impression was made. The parties were conducted over the various works by the Chairman of the Committee (Alderman J. H. Lloyd), with whom was Mr. A. W. Smith (the Manager of the Gas Department) and the various Works Engineers. Satisfaction was expressed with the progress made in connection with the preliminary work for the construction of a large holder at Washwood Heath, Saltley.

Mr. W. A. Twine's interesting lecture descriptive of "What we get from Coal" [p. 929] made quite a popular appeal; and on Saturday afternoon it was repeated, in slightly modified form, before a large assembly of students from the Grammar and Secondary Schools of Birmingham and district. At this meeting Dr. P. D. Innes (Chief Education Officer of the City of Birmingham) presided.

During the week cookery demonstrations, which were held daily, attracted large interested crowds of women and children. Arrangements were made by which the displays could be witnessed by parties of school children, and many of the latter from the elementary and secondary schools also took part in various competitions.

HUMANIZING HOUSEKEEPING.

An interesting subject—that of "Humanizing Housekeeping"—was discussed on Wednesday in a popular lecture by Mrs. C. S. PEEL, late Director of Women's Service, Ministry of Food. This attracted a very large audience, and the chair was taken by Councillor Miss Bartleet (the Chairman of the Birmingham Asylums Committee). It was a spirited plea for the use of more labour-saving appliances, and particularly gas-heated equipment, in the home.

Mrs. Peel pointed out that the shortage of servants had stimulated the demand for labour-saving appliances in the home. Architects, she said, did not pay adequate attention to the question of convenience, when designing houses. If she could have her way, she would make every architect serve a three months' apprenticeship to an efficient charwoman. Trained women were needed to act as Domestic Efficiency Advisers. It would be a great advantage to have a skilled woman on every Housing Committee. The house she wanted was one of what she called the "Turn-a-tap-and-light-a-match Houses." Coal-fires were a nuisance. With gas equipment, the housewife could obtain precisely the heat she required. Much of the bad cooking was due to the food being cooked too fast. Plenty of water was no longer a luxury; it was a modern necessity. The improvement in gas apparatus had been really remarkable. The all-gas house would become more and more possible as the cost of gas was reduced.

Mr. A. W. SMITH said the builder put in a coal-range because there was a demand for it. When the demand was for the labour-saving apparatus of the various types which had been described, then these would be automatically forthcoming. It was for women to make their demands known.

PRESENTATION OF COOKERY COMPETITION PRIZES.

On Saturday afternoon, the Lady Mayoress of the City of Birmingham (Lady Davis), in the Cookery Demonstration Room, distributed the prizes which had been won in the cookery competitions organized in connection with the Exhibition. There was a large gathering of children, teachers, parents, and friends. The chair was occupied by Councillor S. W. B. Stephen (Chairman of the Smethwick Gas Committee); and by his side were Mr. A. W. Smith (Deputy Chairman of the Executive Committee of the Exhibition and General Manager and Secretary to the Gas Department of Birmingham), Mr. R. J. Rogers (Hon. Secretary to the Executive Committee of the Exhibition), Mr. F. R. Ayre, and others.

Councillor STEPHEN, in introducing the Lady Mayoress, spoke of her willingness to give time and help to any good cause, and said he did not know of a better cause, so far as young people were concerned, than that of learning to cook properly.

The LADY MAYORESS expressed her pleasure at being present on this interesting occasion. No girl's education, in her judgment, was ever complete unless she had been taught how to cook food. Few things played a more important part in the national life than cooking—especially so was this the case so far as girls were concerned. When they became mistresses of households, they would realize, if they had not done so before, what an advantage it was to know how to cook properly. Nothing pleased a man more than good cooking. She hoped, therefore, that the girls would persevere with studies in cookery. She congratulated the Committee on the large number of entries for the competition from the area of which Birmingham was the centre. She also tendered congratulations to the successful competitors, and expressed the hope that she might have the pleasure of presenting cookery prizes on some future occasions.

The large number of prizes was then distributed.

Mr. A. W. SMITH proposed a vote of thanks to the Lady Mayoress and Councillor Stephen, and to the Judges—Miss Edith Sanderson, Mrs. Rea, and Miss Pinchbeck. He commended the Judges especially for the way in which they had discharged their arduous duties.

The resolution was carried by acclamation.

A CORRECTION.

We are sorry to find that, in the description of the display of Radiation, Ltd., we used, on p. 834 of the "JOURNAL" for Sept. 19, an illustration of the "Accurette" dial tap on the "New World" cooker, in mistake for the "Regulo" head referred to in the text.

GAS AND FUEL PROBLEMS.

Under the auspices of the Birmingham and Midland Section of the Society of Chemical Industry, a meeting was held jointly with the Midland Junior Gas Association in the Conference Hall at the National Gas Exhibition on Tuesday last week. There was a very representative attendance of junior gas engineers and salesmen.

Dr. E. B. MAXTED (Chairman of the local section of the Society of Chemical Industry) presided; and in opening the meeting he pointed out that apart from its use for heating and lighting, the gas industry would always be of the highest importance by virtue of the chemical industry which it supported. Besides coal tar, sulphate of ammonia, and whatever other development might be made in lighting and power, there would always be a necessity for the gas industry and its bye-products. He then referred to the various papers which were to be presented, and added that he understood the contribution concerning the specific heat of coal in relation to its composition was of particular importance from the point of view of a standardized composition of coal.

THE SPECIFIC HEAT OF COAL AND ITS RELATION TO COMPOSITION.

By G. COLES, B.Sc.

In this paper, the specific heats of various British coals, in the dried and undried condition, were given, and classified according to the different types of coal investigated. The results point to the following general conclusions: The specific heat of coal appears to lie in general between the values ·2 and ·4, according to

the amount of water contained, and for purposes of comparison of specific heat results, the necessity of recording moisture content is pointed out. The water contained by these coals (estimated by heating *in vacuo* at 105° C.) has a specific heat approximating to 1. The nature and general composition of the coal also influences the value of the specific heat; and, when the latter is reduced to an ash-free dry basis, it is shown that coals of the same class possess values of the same order. Anthracites and fusains are shown to agree fairly well with Kopp's law; but bituminous coals diverge from this by about 11 p.ct. Specific heat determinations were carried out by the Bunsen ice calorimeter at an average temperature of 8° C.

The Chairman pointed to the importance of a proper understanding of the many factors which make for the heating of coal. The most important factor was the specific heat of coal. As would be expected, this had been shown to be more or less proportional to the water content of the coal. The differences mentioned by Mr. Coles were wide. From the economic standpoint, the whole subject of coal was beginning to have a greatly increased importance. We were, he believed, right on the fringe of understanding the true composition of coal. We were beginning to find that many things might be extracted from coal, and that coal was not a mixture of carbon and tar, but was a mixture of many complex compounds which were present as such in the coal. His belief was that the next twenty years would see very notable additions to our knowledge as to what was the true composition.

Mr. Geo. King (Hon. Secretary of the Birmingham and Midland Section of the Society of Chemical Industry) read the following contribution from Mr. J. Ivon Graham, Assistant Director of the Mining Research Laboratory, which is supported by the Coal Owners' Committee, at the University of Birmingham: "Possibly something should be said in vindication of such a subject being brought before this meeting in a National Gas Exhibition. The specific heat of coal should, however, be of interest to all those concerned with the raw material, whether in gas-works, coke-oven practice, or underground in the mine. The work which Mr. Coles has described in his paper was undertaken, primarily, in connection with researches being carried out at the Mining Research Laboratory (for the Deep and Hot Mines Temperature Committee) on measurements of the heat production during the oxidation of coal. Directly connected with the latter is the problem of the spontaneous combustion of coal; and in regard to this there is no doubt of the importance of having an accurate value for the specific heat of coal. Spontaneous combustion of coal underground is a phenomenon which costs the mining industry a considerable amount annually in money—to say nothing of the valuable lives lost. The recent disaster at Maltby Colliery, in which 27 men were killed, was caused by a gob fire resulting from spontaneous heating, and as a consequence about 1500 men have been thrown out of work. Cases of spontaneous combustion in large piles of coal stacked for gas-making or household purposes are not uncommon in this country; and so we came to the conclusion that it might be of interest for Mr. Coles to give his results to the Society at the time. Several interesting points have arisen out of this work; one being the influence of composition on the specific heat of a coal. Any new line of attack which may throw an extra gleam of light on the constitution of the substances which make up the coal conglomerate, must be welcomed; and in this connection the study of the relation of the specific heat as determined experimentally and as calculated from Kopps' Law may help us. Mr. Coles' results for bituminous coals show considerably more than experimental error in their divergence from the calculated values. In these coals, we have a low C : H ratio and high volatile matter; on the other hand, German brown coal has also a low C : H ratio and high volatile. In the case of the German brown coal, however, I believe we have a considerable proportion of the hydrogen linked to oxygen in the form of O H groups. Probably in the bituminous coals a smaller proportion of the hydrogen may be present in the form of O H groups, and a greater proportion directly linked to carbon. It seems to me that it is worth considering whether the differences found by Mr. Coles may not be due to differences in the atomic heat of hydrogen when linked to carbon or oxygen respectively. This is, of course, theorizing, but I hope that by future work we shall be able to prove or disprove the idea."

Mr. C. F. W. Rendle (President of the Midland Junior Gas Association) pointed out that the subject was of vast importance to the gas engineer. The present line of research should help them to a better understanding of this complex question. They in the gas industry made perhaps better use of coal than men in most other industries; but they had not yet reached the last word in the successful utilization of coal. The point that struck him as worthy of note was in relation to the varying results that were obtained from the different classes of coal. Some coal constituents were useful to the gas industry, and some were not. Perhaps it was not looking too far into the future to suggest that they would not regard the quality of the coal by the name of the mine; but that the constituents would be given names, and that the coal mixtures would be better separated than they were to-day.

Mr. Alcock considered that the time had arrived when a standardized coal should be supplied.

Dr. A. Parker (of the Coal Gas and Fuel Department, University of Leeds) said he gathered that the determinations of the specific heat of coal formed part of a scheme of research with a view to tracing the origin of gob fires, or of trying to find out which types of coal were most liable to gob fires. He would like to ask if, in the research scheme, the point had been considered as to the heat of distillation of coal. His idea was that combustion first took place in the layer of coal which was most suitably situated as regarded lagging from outside cooling, and yet with sufficient air entering to bring about comparatively rapid oxidation. This layer becoming red hot evolved gas, and at the same time distilled the surrounding layer of coal. In distillation it was possible that heat might be given out, and this might intensify the trouble of gob fires. Several attempts had been made to determine the heat of decomposition of coal. The Gas Investigation Committee of the Institution of Gas Engineers had come to the conclusion, from tests with Lanarkshire coal, that there was very little heat change, but that the probability was that heat was absorbed. It was possible, however, that in the case of some coals heat would be given out during distillation, thus increasing the tendency of gob fires to spread. Differences in heat of decomposition might be as important as differences in the specific heat of coal.

Mr. Coles, replying to Dr. Maxted, said it was true the limits given with regard to specific heat values were wide. It was possible to have a coal of low moisture content and to be an anthracite or fusain, and to have a low specific heat. On the other hand, they might have a bituminous coal, with a great deal of water taken up, which gave a return of ·4. As to Dr. Parker's question, it was true that as the temperature increased the specific heat increased also; the investigation as to the specific heat was really preliminary to the inquiry as to why and how gob fires started.

A NEW GAS COMBUSTION FURNACE.

By Thomas J. Hedley, Chemical Engineer to the Chemistry Department, Birmingham University.

Gas combustion furnaces are used in chemistry for the analysis of organic and carbonaceous substances by complete combustion in a suitable glass tube, forming carbon dioxide and water which are weighed. Nitrogenous substances are similarly burnt, and the nitrogen collected and measured. Existing types of furnaces represent little or no advance in design or efficiency over those in use over half-a-century ago, and are usually expensive, heavy, and cumbrous, easily getting out of order, and very wasteful of gas, time, and human energy.

This new furnace is readily portable by one person, costs considerably less than any other furnace, is economical of gas, and can be operated with both precision and comfort. The essential features are a multiple-flame burner with separate control of each flame; gas being admitted at each end of the burner (which is partitioned at the centre) by a series of jet holes—the number in use being controlled by a screw plunger. The burner is self-regulating as regards air-gas mixture, the air intake by induced draught being governed by the number of jets in use. By this means, any type of flame can be obtained, or any number of flames; the number of flame orifices open being varied from the front underneath the burner by simple heat-screened thumbscrew valves. Adequate provision is made for the protection of the operator, the bench, and the bungs of the combustion tube, by suitable hinged and fixed refractory screens.

These furnaces are in daily use in universities and colleges—at Birmingham, Edinburgh, Leeds, Liverpool, &c.—and are made and supplied by Messrs. W. & J. George, Ltd., of Birmingham.

The Chairman said he had seen the furnace in successful operation at the Birmingham University, and he was satisfied that it had many points of advantage over the ordinary furnace. The external means of regulating the flame represented a point of great attraction; it was far better than having to reach under a row of hot burners. Again, the regulation of individual burners could be done in such a way as not to cause injury to the fingers. He agreed that much chemical apparatus had become out of date.

Mr. Benton commented upon the old-fashioned character of many laboratory furnaces, and welcomed the new furnace, which appeared to have many small improvements, the result of experience.

Mr. Alcock inquired what was the life of the apparatus, and spoke of the bad effect of sulphur upon the connections and fittings.

Mr. H. R. Hems (Birmingham Gas Department) remarked that, though he was familiar with the design of many furnaces for use by manufactories in the Birmingham district, the thought of a combustion furnace for the chemist had never occurred to him. He believed something had been evolved which would be of great use. It would be a good thing if the various industries would tackle these problems. Gas departments—certainly Birmingham—were willing and anxious to render the most efficient service; but it frequently happened that the whole burden, as to the designing of the furnaces, &c., fell upon the department.

Mr. Rendle said it occurred to him that it might be advisable to dispense with the double fillet of refractory material which obtained in the centre, and which must at that point tend to lower the temperature. He thought it would also be found advisable to protect the metal at the sides as well as at the bottom and the back. Mr. Hedley was to be congratulated upon departing from old-fashioned principles.

Mr. Shatwell (Mining Research Laboratory, University of Birmingham) said that, while the furnace represented many things that were new and comprised an excellent design, he personally felt that the aim as regarded producing a light instrument had gone rather too far. His view was that the question of portability in a laboratory did not matter very much, generally speaking; and he suggested that if Mr. Hedley had occasion to design another furnace, he would make it slightly heavier. The relatively short life of the nickel trough, due to sulphur, and of the tiles had also to be considered.

Dr. A. Parker said, with regard to the suggestion that the nickel trough was more satisfactory than one of iron, he would have expected more rapid deterioration of nickel owing to the presence of carbon monoxide in the flame. It was largely a question of air regulation; but as had been pointed out, the jet was not centrally placed when the burner was turned down. This might cause more rapid deterioration than in the case of iron.

Mr. Hedley, in reply, stated that with regard to the gas mixture they had found by experiment, when they had the whole of the burner tubes in operation, the correct number of jets to employ in the end piece so as to obtain a certain air-gas mixture suitable for burning. With all the jets on, the mixture was rather rich, but the quality could be altered by screwing-in the plunger. As the number of flames was reduced, the air-gas mixture was automatically regulated. With regard to the concentricity of the jet, the screw valves passed through the centre of the tube, and these had a slight baffling effect upon the incoming gas. This was enough to make a

good mixture, and yet was not a sufficiently great obstruction to prevent the overflow of gas to further burners. Screw valves passing through the tube served to spread the gas and mix it equally. As to the life of the furnace, experience was not adequate yet to give an opinion; those which were in use had not depreciated at an enormous rate. He had not noticed anything except perhaps some mischief to the nickel tray. With regard to the weight of the furnace, he pointed out that the reduction came about when an effort was made to reduce the size of the refractories and the heat capacity of the iron work. He did not think that carbon monoxide would be generated in the flames. An important point was that one could arrange to get the mixture required. It was true that the nickel tray became rotten in a short time. Iron trays were formerly used. These buckled badly on heating, and the tube also twisted and wore unsatisfactorily. Nickel chrome was tried, and warped considerably; nickel warped the least. The nickel tray, if picked up carefully, would not break.

CALORIMETRY: A NEW AUTOMATIC PRESSURE AND TEMPERATURE CORRECTOR FOR GAS VOLUMES.

By C. H. BEASLEY.

The subject of calorimetry is now engaging a good deal of attention both from gas manufacturers and consumers; and it is interesting to note the improvements in calorimetric apparatus. The Beasley recorder, manufactured by Messrs. Parkinson and W. & B. Cowan, has had some very important improvements effected in its design, chiefly relating to the gas-measuring part of the apparatus.

In the report of the Research Sub-Committee of the Gas Investigation Committee of the Institution of Gas Engineers, the principal defects pointed out in this instrument were the frequent necessity for re-adjustment of the meter water line, and the chart readings needing correction for barometer and temperature variation. These defects have been remedied. The meter water line is now maintained at a constant level by a small storage tank holding enough water to keep the meter correctly lined for several days without attention. By a very simple and effective device, a constant drip of water is supplied from the storage tank to the meter, slightly in excess of that required to meet losses by evaporation and conditions of saturation of the gas passing. Any excess of water escapes over a weir to a water tank, from which it can be transferred again to the supply tank. The amount of water necessary for ten days or so being only trifling, the storage tank is a small affair; and the whole arrangement goes into a trifling space.

With regard to the device for correcting the volume of gas to standard conditions, it will be remembered that the gas control to the instrument is effected by a pendulum-controlled clock escapement to the meter drum, by which means the volume passed is kept constant, irrespective of temperature, barometric pressure, or density changes. But now, by a very simple device, the pendulum rate of oscillation can be automatically varied in direct proportion to the alteration of volume of the gas passing through the meter owing to temperature and pressure conditions. The main novelty about the device is what one might call a brake, in the form of a flat steel spring used to oppose the motion of the pendulum on the constant flow meter. The mechanism for this moves practically without friction; the brake spring being carried at the end of an arm of a lever operated by a set of fluxing diaphragms, forming part of a vessel containing a locked amount of air in the presence of water. The vessel itself, and also the diaphragms, are in contact with the gas stream, and take up the same temperature. It will be seen from this description that the diaphragms and lever arm move in accordance with changes of pressure in the air vessel or by external atmospheric pressure changes. The volume of the air chamber being large in proportion to the fluxing capsules, the movements obtained by changes of pressure are closely proportional to the magnitude of these changes, so that the brake spring, we may say, moves distances proportional to the pressure changes.

If, now, this brake can be applied to a pendulum in such a way that its movements shall cause corresponding rates in the pendulum, we shall get a gas drum turning at a rate corresponding to changes of temperature and pressure. A common way of altering the rate of a pendulum is by raising or lowering the bob. This method, however, does not produce rates in the pendulum in simple proportion to the distance moved by the bob, but varies in proportion to the square root of the length of the rod; and the distance the bob is displaced is quite a large amount to produce a change of rate equal to (say) 10 p.ct. It was found by experiment that, if a brake in the form of a flat steel spring could be applied to oppose the motion of the pendulum in such a way that the opposition force itself was a constant amount, then, by applying this brake at different points from the fulcrum or suspension point, the rate of the pendulum varied in direct proportion to these distances.

These conditions are complied with in the apparatus now in use. The stud at the end of the brake spring comes in contact with the sides of a taper slot made in a thin metal plate, forming the upper part of the pendulum rod. The sides of this slot, if extended, would be equal to the arc of oscillation—in other words, the slot is a section of the arc of oscillation. The end of the brake spring moves vertically up and down this slot; and its position is determined by the movements of the capsules expanding or contracting with changes of volume of the trapped air and water vapour in the air vessel. Whatever part of the slot the spring happens to be in, the amount of flexing or the extent to which it is bent remains the same. Consequently its opposing force is constant in amount; and by applying this opposing force in the manner indicated, the pendulum rates are found to be proportional to the distances the brake moves to and from a given position. This given position, we may say, is the zero, and is the point in the slot where the brake spring rests when the temperature and pressure conditions are normal. If the brake moves below this point, the pendulum rate is increased; if it goes above this point, the rate is retarded by amounts proportional to the pressure and temperature changes. For convenience of checking the position of the brake from its zero position, a scale graduated in percentages of increase and decrease is fixed to the front of the meter; and the position of the index shows the ± amount that is applied to the rate to get normal conditions.

One charming feature about the corrector is that its movements are practically free from friction. The arm turns on pointed pivots, and the stud at the end of the spring only comes in contact with the slot at the end of the pendulum beat. The meter without the corrector delivers a constant volume of gas irrespective of pressure, temperature, and density; but with the corrector it delivers a constant amount.

Discussion.

Mr. C. F. W. RENDLE remarked that the instrument was of peculiar interest to gas engineers for works-control purposes. With regard to net-value calorimeters, it was a matter of importance to use them, especially as they were now working under the Gas Regulation Act. He thought Mr. Beasley would have done better if he had laid stress on the point that the instrument could be set to meet their requirements. Recording calorimeters were of chief use to them as works-controlling instruments, and they lost much of their value if they did not give the gas engineer a correct record as to temperature and barometric conditions. The instrument would appear to have features of great value, and many of them would doubtless welcome a personal trial. He regretted that the attachment for the determination of the water line was abolished in the present meter. To what extent was the water liable to bank-up against the thick wall tube?

Mr. J. W. WOOD (Fuel Department, Leeds University) observed that the Beasley recorder enjoyed a well-deserved popularity throughout the country. It was a net-value instrument in the sense that the products of combustion left the top of the chimney at a temperature higher than that at which water vapour could be condensed out; the whole of the heat was not absorbed in the instrument. He did not imply that the instrument gave a value which was too low. In its calibration, things were carefully arranged so that the correct value was shown irrespective of the loss at the top of the chimney. In an official report on the subject, they were careful to show that over a wide range of calorific values the ratio of gross to net was substantially constant. It was not, however, that the difference between gross and net was so small that it could be neglected. The difference was 10 p.ct., but the variation was substantially constant. He thought it was doing the instrument a serious injustice, now they had come to regard the gross calorific value as the official value, to class the instrument as a net instrument, since it was liable to cause a certain amount of distrust. It would be justifiable to term the instrument a gross recorder. He was pleased to know that the designers realized the conditions which must be fulfilled with regard to pressure. Unless the governors at the inlet meter were carefully regulated and the pressure at the burner was very low, there would be variations in the rate of the meter. The makers were well aware of this. He took exception to the use of carbon monoxide for standardizing the instrument. It was certainly far preferable to calibrate the instrument with the kind of gas upon which it would subsequently be used.

Mr. R. G. MARSH (Birmingham) said, though he had had no experience with the instrument since the new addition was made, he appreciated that Mr. Beasley had overcome various difficulties. He had long admired this calorimeter, and particularly the ingenious adaptation of the pendulum to the meter mechanism; and at one time he had hoped to be able to make some such addition. He saw that the only thing required to complete the instrument was some means of automatically controlling the flow of gas through the meter and conforming it to the variations in atmospheric temperature and pressure. He and a colleague did some experimental work, by altering the depth of the drum in relation to its immersion in the water in the body of the meter. This was not successful, however, mainly through mechanical difficulties of construction.

Dr. A. PARKER said that Mr. Beasley was to be congratulated on the way in which he had overcome the various difficulties. Some time ago he gave the matter some attention. He tried to make the same corrections by variations in the length of the pendulum; and he and a colleague worked out the variations required to correct for the changes in temperature and pressure. They came to the conclusion that they could not treat the pendulum with a weight so large as that used in the Beasley calorimeter as with a simple pendulum, and they were unable to correct to the required extent over a large range. They wanted to get the calorific value within 1 p.ct. over a wide range of changes in temperature and pressure. They could, however, only get within 2 p.ct. over a temperature range of 35° to 85° Fahr., and 27·5 to 31·5 in. barometric pressure.

Mr. WOOD inquired if any means were provided by which adjustments could be made in the air vessel or in the leverage of the arm. Mr. Beasley replied that such adjustment could be made by a simple screw arrangement.

Mr. L. H. THOMAS (Senior Vice-President, Midland Junior Gas Association) pointed out that draughts might cause great fluctuations, and that some correction would have to be made for these. Had any attempt been made to overcome this difficulty?

Mr. BEASLEY replied to some of the points raised in the discussion. He said the weir kept the water-line very constant and to a high degree of accuracy. As to the effect of draughts on the instrument, it was obviously necessary to use a little judgment in selecting the position for it. No difficulty should be experienced on this account.

CITY OF BIRMINGHAM GAS DEPARTMENT.

A Valuable Brochure.

The receipt has to be acknowledged, with thanks, of a remarkably interesting and beautifully got-up brochure prepared by the City of Birmingham Gas Department. Profusely illustrated by photographs, the publication, which was circulated among the members of the City Council, in connection with an official visit paid to the works last week, gives a complete history of the undertaking, with a full description of the plant as it exists to-day, and other matters.

Magnitude of the Concern.

The undertaking supplies gas not only to the City of Birmingham, but to districts beyond the city boundary, including Sutton Coldfield, Wednesbury, and Darlaston, the area of supply covering 125 square miles. The manufacturing capacity of each of the five gas-works—which occupy a total area of 96 acres—is as follows:

	Daily Manufacturing Capacity. Million Cubic Feet of Gas.	
	Coal Gas.	Water Gas.
Windsor Street Works	17	4½
Nechells Works and coal-test plant	15	6
Saltley Works	10	—
Swan Village Works	4	1½
Adderley Street Works	2	½
Total	48	12½

The total gas storage accommodation at all works is 38,824,000 c.ft.
Coal used per week during heaviest period—21,250 tons.

Maximum gas output—Per annum	12,821,024,000 c.ft.
Per day	55,901,000 ,,
Per hour	3,985,000 ,,
Length of mains, 987 miles.	
Number of consumers—Ordinary meters	88,060
Automatic meters	104,602
Total	192,662

Historical.

Birmingham may be justly proud of its early connection with the industry of gas making, which, in practical form, actually originated in the district. Prior to the year 1792, various scientists had interested themselves in the subject, and valuable discoveries resulted from their experiments; but no practical application of gas manufacture was attempted until William Murdoch was successful, in the year named, in illuminating his house at Redruth, in Cornwall. Murdoch had, as a youth, carried out certain investigations with the distillation of shale; and when Messrs. Boulton and Watt transferred him to Cornwall, he continued his researches, which were ultimately crowned with success. The discovery of gas lighting was sensational.

About the year 1798, Murdoch returned to Birmingham, and erected a larger plant at Messrs. Boulton and Watt's works; the gas produced being used for illuminating their principal buildings. During the Peace Celebrations of 1802, he brilliantly lighted the outside of the works by various designs; the display gaining much admiration. The preliminary work thus performed by Murdoch acted as an incentive, and several persons in Birmingham installed plants for the lighting of their factories. One—Josiah Pemberton—commenced the manufacture of gas-making plant. At that time, gas was used almost entirely for lighting; its application for heating purposes being of more recent inception. The utilization of the residuals produced by the carbonization of coal had not at that period been considered.

Records indicate that there were a few gas-lamps in the streets of Birmingham in the year 1811, the gas being supplied by private enterprise; but the town does not appear to have reaped the fuller advantage of the discovery of gas until 1817. About that period, a Mr. John Gostling erected a small gas-plant (of which nothing now remains), in a street off Broad Street, appropriately called Gas Street, and laid pipes for the supply of gas by agreement with the Street Commissioners and with private consumers.

Mr. Gostling's business was later converted into a Company under the style of the Birmingham Gas Light and Coke Company, which was incorporated by Act of Parliament in 1819 and took over Mr. Gostling's business on Oct. 19 in that year.

Some curious facts relating to the early supply of gas in Birmingham may be gathered from the records of the old undertakings. For instance, Mr. John Gostling made arrangements with various individuals in the centre of the city, who each agreed to use "16 burners at an annual rental of £62 6s." It appears that payments for gaslight supplied were made half-yearly "in advance," and consumers were prohibited from using burners of larger dimensions than those contracted for. This was, of course, prior to the invention of the gas-meter by Clegg. The Act promoted by the Birmingham Gas Light and Coke Company in 1819 provided that the services to the public lamps should be of a diameter of not less than ½ in. in the bore, and "shall be kept fully charged with inflammable air or gas."

In 1825, a second Company, styled the Birmingham and Staffordshire Gas Light Company, was established for the supply of gas to the town and district; distributing not only to Birmingham, but to West Bromwich, Tipton, Oldbury, Smethwick, Walsall, Bloxwich, Wednesbury, and Darlaston. Power was given in this Company's Act of 1845 to sell the undertaking to the Corporation of Birmingham—destined to be realized thirty years later. The operations of the two competitive Companies caused considerable inconvenience to the authorities; the breaking-up of the streets, in which each had equal rights, being a particularly irritating point. The Companies themselves were also put to some expense and trouble in watching each other's operations; it being not unusual for one Company accidentally to tap the other Company's main in giving a supply to a consumer.

In 1874, both Companies had Bills before Parliament for the purpose of enabling them to raise capital for the extension of their works, and for amalgamation. These Bills were opposed by the Birmingham Town Council, who, at their meeting on Jan. 13, 1874, decided to promote a Bill in Parliament for the purchase of the Companies by the Corporation. Subsequently the two Companies came to an agreement with the Corporation as to the terms of purchase, and the Birmingham Corporation Gas Bill passed Parliament on July 15, 1875; the Royal Assent being given on Aug. 2 of that year. Thus the interests of the two undertakings, with all their statutory powers, came under the control of the Corporation.

It is well known that Mr. Joseph Chamberlain, who at that time was Mayor of the town, played an important part in the acquirement of the two Companies; and, after the completion of the purchase, took a great interest in the administration of the concern, being a very active Chairman of the Gas Committee for some time. The gas powers in the areas of West Bromwich, Oldbury, Tipton, Smethwick, Walsall, and Bloxwich were subsequently acquired by the respective local authorities by purchase from Birmingham.

Progress.

The history of the Birmingham gas undertaking since its acquisition by the Corporation in 1875 has been one of continued progress; and it is a laudable fact that, from such a small beginning, the citizens of Birmingham have as an asset to-day an undertaking which is the largest provincial concern manufacturing and distributing gas in the United Kingdom. The department is looked upon as a pioneer in the gas industry; and, from time to time, persons from all parts of the world visit the works to view and investigate the plants and methods of manufacture and distribution which are adopted. Rapid strides have been made in gas manufacture since the beginning of the present century; and modern plants are remarkable for their scientific construction and economy in working. Machinery now fills an important place in modern gas-works practice; and the prevailing conditions show a marked contrast with those in vogue when the retorts were charged and discharged entirely by means of hand labour.

Windsor Street Gas-Works.

Engineer, Mr. G. C. Pearson.

These works were transferred to the Corporation of Birmingham from the Birmingham Gas Light and Coke Company in 1875, and at that time occupied an area of only 9 acres. To-day, they are the largest gas-works owned by the department, and cover an area of 26 acres. Within recent years, the whole of the Windsor Street Works has been reconstructed with modern type carbonizing plant.

The carbonizing plant consists entirely of Woodall-Duckham continuous vertical retorts, with a total daily productive capacity of 17 million c.ft. of gas. There are six rows of vertical retorts. Five rows are of 5-ton capacity per retort, and the other row of 7-ton capacity per retort; the total number of retorts being 252. The plant is capable of carbonizing 1300 tons of coal per diem. The waste heat from the settings is utilized for the generation of steam required on the plant. It is carried to six Babcock and Wilcox water-tube boilers, and by this means over 40,000 lbs. of steam per hour are raised when the whole plant is at work. Steam is admitted into the retorts, thereby generating water gas for admixture with coal gas; and the excess steam is used for general purposes on the works.

The carburetted water-gas plant at Windsor Street consists of four sets of Humphreys and Glasgow generators, with a total nominal capacity of 4½ million c.ft. of carburetted water gas every twenty-fours hours. Waste-heat boilers are arranged to two of the sets, capable of providing steam for their requirements.

Nechells Gas-Works.

Engineer, Mr. E. B. Tomlinson.

The Nechells works are the most recently constructed works of the undertaking. The total area is about 24½ acres.

The principal carbonizing plant consists of 120 Woodall-Duckham continuous vertical retorts, each capable of carbonizing 7 tons of coal per day; the capacity of the whole plant being 840 tons of coal in 24 hours, and producing in that period 10½ million c.ft. of gas. Four waste-heat boilers have been installed, which give sufficient steam for working the whole of the plant, and provide a surplus for general works requirements. Other carbonizing plant comprises 32 beds of eight horizontal retorts, a total of 256. This plant was erected in 1916, and has a productive capacity of 4 million c.ft. of gas per day from about 350 tons of coal. These horizontal retorts are charged and discharged simultaneously with Fiddes-Aldridge machines. The water-gas plant consists of six sets of Humphreys and Glasgow type machines, with a total nominal capacity of 6 million c.ft. of gas per diem. Four of the sets are capable of producing either

carburetted or blue water gas, and the other two sets are designed for blue water gas only.

Saltley Gas-Works.

Engineer, Mr. T. H. Hack.

These works, the site of which covers an area of 18 acres, were taken over by the Corporation on the acquisition of the Birmingham and Staffordshire Gas Light Company.

The carbonizing plant at Saltley mainly consists of a battery of 66 "Koppers" type ovens, which were installed in two sections between the years 1912 and 1914. This plant is capable of carbonizing 400 tons of coal and of producing 5 million c.ft. of gas per diem, and is distinctive, inasmuch as it is the only coke-oven plant of its kind in this country the gas from which is utilized solely for town's purposes. The coke produced from the ovens is very dense, and is eminently suitable for blast-furnace and foundry work, finding a ready sale in the Birmingham district. The ovens are heated by means of Mond gas produced on the works; this latter plant being capable of gasifying 100 tons of coal per day and producing 12 million c.ft. of Mond gas in 24 hours. Special coal-handling plant, stamping, charging, and coke-quenching machines have been installed in connection with these ovens. The other carbonizing plant comprises 416 Ω section inclined retorts, in two retort-houses, which are capable of carbonizing 400 tons of coal and producing 5 million c.ft. of gas per day.

Swan Village Gas-Works.

Engineer, Mr. R. A. S. Browning.

The Swan Village works originally belonged to the Birmingham and Staffordshire Gas Light Company, and were built in the year 1825. They have an area of 22 acres. The gas from these works is distributed to the Wednesbury, Darlaston, and Handsworth districts.

The carbonizing plant consists of fourteen beds of eight horizontal retorts each, charged and discharged by means of Fiddes-Aldridge stoking machines, and eight beds of four retorts each of Woodall-Duckham continuous vertical retorts. The combined units are capable of dealing with about 300 tons of coal per day, with a production of 4 million c.ft. of gas in 24 hours.

There are two carburetted water gas plants by Messrs. Humphreys and Glasgow, which are nominally capable of producing 1½ million c.ft. of gas per day.

Adderley Street Gas-Works.

Engineer, Mr. G. A. Bamber.

These works are the smallest belonging to the department, and were erected by the Birmingham and Staffordshire Gas Light Company about the year 1844. The area occupied is some 5½ acres.

The carbonizing plant consists of 20 beds of horizontal retorts heated by regenerative furnaces; the retorts being charged and discharged by an electrically-driven Fiddes-Aldridge machine. This plant is capable of making 2 million c.ft. of gas per diem. There is a blue water-gas plant at Adderley Street, with a nominal productive capacity of 500,000 c.ft. per day.

Coal-Test Works.

The plant here comprises various systems of carbonization, with complete purification plant, on a full-sized manufacturing scale, capable of dealing with about 10,000 c.ft. of gas per hour. Many important experiments in manufacture and purification have been carried out at the coal-test works, to the department's advantage. Before large quantities of coal are purchased, samples of about 100 tons of the material offered are sent forward to the coal-test works, in order that a test on a working scale may be made, with a view to ascertaining the suitability or otherwise of the coal for use on the larger works. This plant is under the charge of the Chief Chemist of the department (Mr. T. F. E. Rhead, M.Sc., Manc.).

Proposed New Works at Washwood Heath.

The Gas Committee have not lost sight of the future development of the city, with its corresponding demand upon the resources of the undertaking, and have acquired land at Washwood Heath, from the Tame and Rea Drainage Board, for the construction of another gas-works. Parliamentary sanction was obtained in 1912 for the use of this site for gas-works purposes. Though it is anticipated it will not be necessary to erect a complete gas-works there for some few years to come, it has been found essential to provide further storage accommodation for gas; and two large three-lift telescopic gasholders, each of a capacity of 5,900,000 c.ft., are now in course of construction on the site. It is proposed to extend these holders to five lifts at a later date, which will increase the capacity of each holder to 10 million c.ft. The scheme provides for a gas-works with an output of 20 million c.ft. per day. The area of land owned by the department at Washwood Heath is 34 acres.

The total daily productive capacity of all the works (the Engineer-in-Chief of which is Mr. J. Foster) is approximately 60½ million c.ft.

There will be general agreement with the final words appearing in the brochure: "The concern is now approaching its fiftieth birthday; and its present sound position would indicate that the decision of the City Council in 1875 to take over the businesses of the two Gas Companies then supplying the district has been more than justified."

PROGRESS IN THE GAS-METER INDUSTRY.

Extensions at George Glover & Co.'s Chelsea Works.

In the year 1859 "The Sales of Gas Act," 22 & 23 Vict., Cap. 56, for the first time defined and enacted a standard measure to be used in the sale of gas. This was the cubic foot, a volume occupied by 62·321 lbs. avoirdupois weight of distilled water at a temperature of 62° Fahr., the barometer standing at 30 in. of mercury. A cylindrical copper vessel with conical ends was accordingly prepared, complying with these requirements, and was deposited in the Standards Department at Whitehall. This was only the first step, and could not be used for the practical purpose of testing the gas-meters used by consumers, and in 1860 it was found necessary to pass an amended Act postponing its operation for another twelve months.

At this point Dr. George Glover, who was not only an M.D., but had been Lecturer on Mechanical Philosophy in Edinburgh, was entrusted with the duty of preparing the proper instruments for carrying the Act into operation. In this work he had the assistance of John Adamson (an expert in the mixing and use of the special anti-corrosive alloy which Dr. Glover employed) and also of his nephew, J. Wm. Glover, both of whom had previously been for many years with the old gas-meter firm of Croll and Glover.

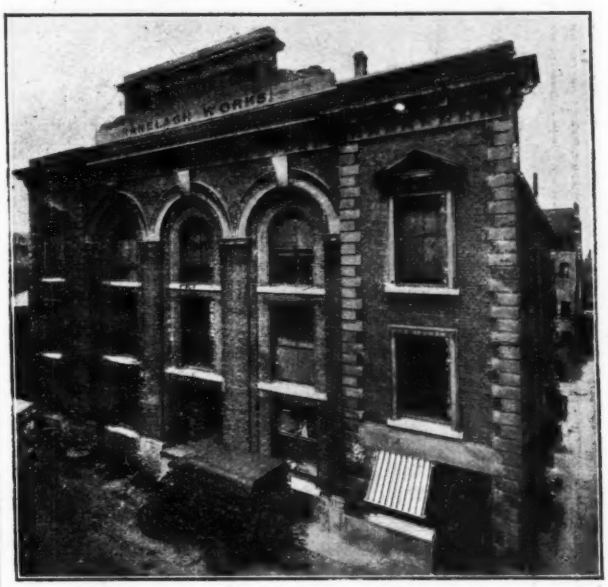


Fig. 1.—Front View of the Works of Messrs. George Glover & Co., Ltd., Royal Avenue, Chelsea.

Dr. Glover devised a "direct transferrer," so that the gaseous contents of the "cubic-foot bottle" could be transferred without error to any other container and be used for the graduation of the test "gasometers." He also designed and applied for a patent for test gasometers whose bell or container should be made of metal which would resist the corrosive action of the various constituents of coal gas and water. These test gasometers in sets of three—1, 5, and 10 c.ft. capacity respectively—were made under Dr. Glover's personal supervision at the engineering works of Messrs. Bryan Donkin & Co., of Bermondsey, the scales being afterwards carefully graduated and engraved on each by Messrs. Negretti & Zambra. When completed, the Astronomer Royal (Prof. Airey) reported officially that they were "as perfect as human skill could make them." One set was deposited at the Standards Department, Whitehall, and duplicates with the Chief Magistrates of London, Edinburgh, and Dublin.

It is interesting to note that Dr. Glover at that time had a duplicate of the 5 ft. test gasometer made for his own use, and that this instrument may still be seen in the Proving Department of George Glover & Co., Ltd., Ranelagh Works, Chelsea. It is still, after an interval of well over half-a-century, in a state of complete preservation.

The Sales of Gas Act not only introduced a standard measure for gas, but prescribed in gas-meters a limit of error of 2 p.ct. in favour of the seller and 3 p.ct. in favour of the buyer. It was found that many of the old wet meters could not be adapted to this limited range; and Dr. Glover (as soon as his work for the Standards Department was completed) set himself the task of introducing the same personal supervision and meticulous attention to detail in the design and manufacture of dry gas-meters which he had so successfully applied to the standard instruments. Accordingly, in 1861, we find Dr. Glover taking out a patent for dry gas-meters and pneumatometers. Patents had previously been taken out for dry meters with one, two, three, four, and six measuring compartments; but he found the two-diaphragm meter invented by Wm. Richards, and patented in 1844, at once the

simplest and most satisfactory—practically the "survival of the fittest." This meter had been made first by Croll and Richards, and then by Croll and Glover till 1858, when they dissolved partnership on the expiry of the original patent.

Dr. Glover started a small works in Abingdon Street, Westminster (in charge of John Adamson), and an office at No. 22, Parliament Street (in charge of J. Wm. Glover). He was fortunate in interesting Mr. Samuel Scott, of the old banking firm of Willis Percival & Co., Lombard Street, in his venture, and took his nephew (Russell Scott) into partnership.

Dr. Glover made various alterations in the detail of the meter and omitted the brass badge, putting the maker's name, number of identity and other particulars required by the Act, on the enamelled dial. Patterns of the various sizes were put in hand at once, and also several Exhibition models in bevelled plate cases showing all the working parts of the meter in action. In 1862 these were shown at the International Exhibition at South Kensington, in which Dr. Glover exhibited the copy of the 5 ft. standard test gasometer, glass cased dry meters, and the pneumatometer for testing the capacity of the lungs, with other apparatus. This interesting exhibit was open for six months, and was in personal charge of Mr. J. William Glover; Dr. Glover himself attending from time to time and by appointment. The following awards given in the engineering class, and also in the class for gas-meters, were very useful in calling attention to the George Glover dry gas-meters:

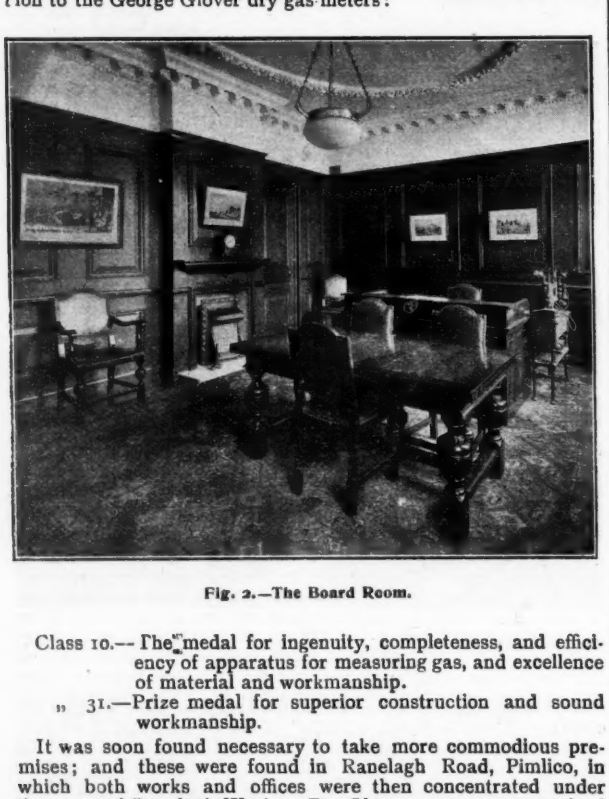


Fig. 2.—The Board Room.

Class 10.—The medal for ingenuity, completeness, and efficiency of apparatus for measuring gas, and excellence of material and workmanship.

" 31.—Prize medal for superior construction and sound workmanship.

It was soon found necessary to take more commodious premises; and these were found in Ranelagh Road, Pimlico, in which both works and offices were then concentrated under the name of Ranelagh Works. Dr. Glover very soon organized an experimental department and put this in charge of Mr. Graeme Tomkins, a mathematician of infinite patience, whose work in the graduation of the standard instruments had commended itself to him.

The gradual amalgamation of the old London gas companies—the Chartered, Imperial, Independent, Western, Phœnix, Ratcliff, London, &c.—had combined to form a united Company under the title of the Gas Light and Coke Company, with whom Dr. Glover arranged a contract for his firm for the repair and renewal of all the dry meters west of Temple Bar, taking over at the same time a number of the men who had formerly been in the employment of the Company, which had previously repaired its own meters.

The business continuing to grow, larger premises were found at Chelsea—the site of the present factory—prior to which two sons were taken into partnership—D. Thomson Glover and George Raleigh Glover. Thomson Glover's training as an engineer stood him in good stead; and on the death of John Adamson he became practically his own foreman, George R. Glover undertaking the commercial responsibility. This arrangement was very successful, and lasted until the death of their father in November, 1899, at the age of 95. Dr. Glover had continued to be the senior partner to the day of his death, and was at the office door in his cab the day before.

Latterly Dr. Glover had not taken an active part in the business; but the personal oversight which he inaugurated was carried on by Thomson Glover, who insisted on examining each meter individually, especially the position and movement of the diaphragm, before it was closed in. This practice he kept up until the advent of the coin meter, when the numbers turned out necessitated his deputing this important duty to specially trained examiners. The result of this system of personal attention to detail has proved so satisfactory that it has been continued to the present day; and in later exhibitions the firm of George Glover & Co. have been able to exhibit dry meters made to measure 900 c.ft. per hour, actually measuring the gas consumed by one burner using only 6 c.ft.—a thing which had previously been said to be impossible with a dry meter.

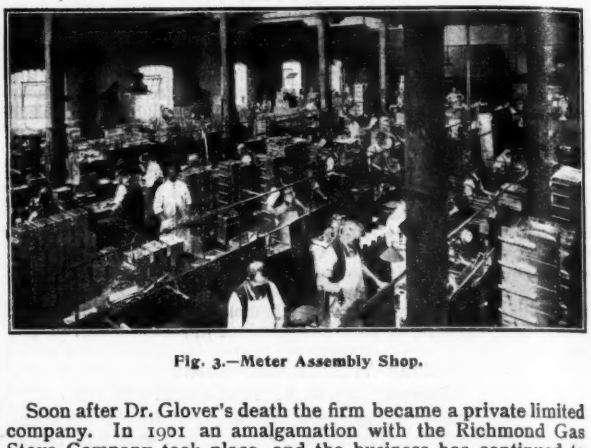


Fig. 3.—Meter Assembly Shop.

Soon after Dr. Glover's death the firm became a private limited company. In 1901 an amalgamation with the Richmond Gas Stove Company took place, and the business has continued to grow and prosper.

The manufacturing side of the business is still carried out on up-to-date lines, and great attention is given to minute details and the testing of each meter under full outlet capacity at heavy pressure, so as to prevent "slow" registration which might otherwise occur if the meter was overworked.

The coin movement of the firm had the distinction of being adopted by the South Metropolitan Gas Company, who have since used it exclusively for all their coin meters. It has the unique advantage of being easily adapted to indicate in "therms" instead of cubic feet the gas paid for.

The latest development has been the introduction of the "Ranelagh" prepayment meter under Patents Nos. 143,679 and 145,165, which provide a coin meter in which all the operations take place in front of the meter. This meter has been adopted by many of the largest gas undertakings in the kingdom. Its success and the general expansion of business have necessitated the rearrangement and extension of the works at Chelsea, which are still closely associated with the Glover family under the direction of the General Manager, Albert Wm. Glover.

Extensive alterations and additions have been made to the original fabric, resulting in added floor space and a much-improved lay-out, which greatly facilitate the progression and control of work through the factory. What was until recently an open yard has been covered in with a saw-tooth roof, forming a spacious shop of four bays, with a total area approximating to 6500 sq. ft., the whole of which has been well equipped and is now devoted entirely to repair work. Additional lifts have been installed, and transport facilities for meters and components parts between the various departments have been much improved.

It was found necessary to provide a larger testing and proving room to cope with the growing output. This is capable of dealing with the increasing production, and of ensuring the accuracy of the meters, both new and repaired, all of which are subjected to rigid inspection and test prior to leaving the works.

The meter painting section has been transferred to a larger and more convenient shop, where additional spraying units and ample drying racks have been erected.

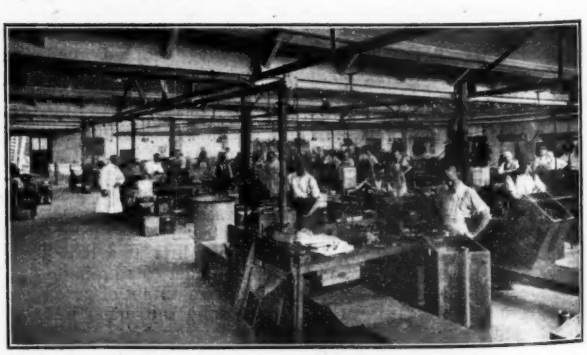


Fig. 4.—Meter Repair Shop.

The congestion in the new meter assembly shop has been relieved by the addition of another floor, and adjacent to this the leather cutting and equipment section has been installed.

To effect quick dispatch, in response to the constant demands for the various types of meters, a new store-room, with rack capacity for over 4000 finished meters, has been provided.

STEAM-JET FURNACES—ANCIENT AND MODERN.

Being a Description of Thirty Years' Experience in the Design of Highly Efficient Steam-Jet Forced-Draught Furnaces as Exemplified by the Latest Development in the Wilton Patent Furnace.

Pioneering work of any description is in general a thankless task; and the engineering profession is no exception to this rule. We of the present generation, with all the advantages on our side as regards training and available sources of information, are apt to be hypercritical of the efforts and designs of our predecessors, without taking into account the initial difficulties which the pioneers of any specialized lines were forced to overcome. The evolution of the steam-jet operated forced-draught furnace for burning the coke dust and screenings on gas-works generally is typical.

Between thirty and forty years ago, it became obvious that steam could be raised more cheaply and just as efficiently if means could be found whereby such fuels as coke breeze could be burned on Lancashire boiler grates; and with this end in view, Lieut.-Col. Thomas Wilton (Chief of the Tar and Ammonia Products Works of the Gas Light and Coke Company at Beckton) evolved the first Wilton grate. Too much importance cannot be attached to this point, as with the original grate as designed by Lieut.-Col. Wilton the hollow-bar type of grate was created.

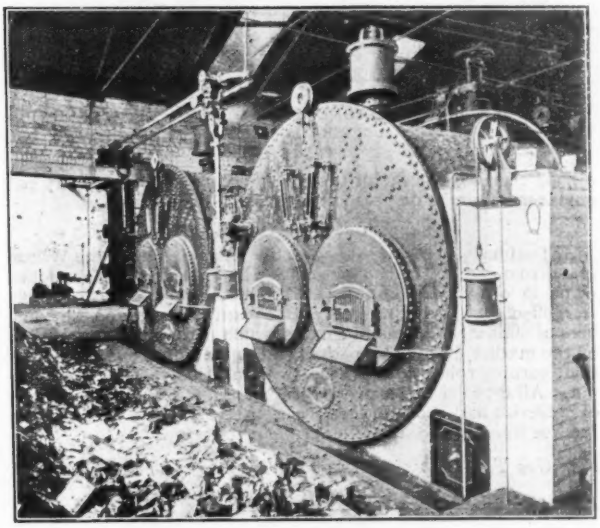
The Original Wilton Grate.

This pioneer grate of thirty-five years ago did not consist of a sectional grate as at present. The first grate consisted of one casting divided longitudinally into a number of circular spaces, and was placed in the bottom of the flue of either a Lancashire or Cornish boiler; the forced draught being provided by means of the steam jet and venturi tube. The surface of the grate was covered with tiny holes, through which the air and steam under pressure were forced through the bed of fuel. With regard to the steam-nozzle arrangements, special cast venturi tubes were bolted to the end of the grate casting—the design of which cannot be said to have altered considerably in any type of grate up to the present day—and the steam jets were specially designed to give the exact amount of spread required to operate the blowers efficiently. Being a pressure furnace, the front plate covered the whole of the furnace opening, and the specially designed cast-iron door was provided with the usual sliding grid arrangement for the supply of secondary air, and also a cast-iron baffle to prevent damage to the door through overheating. Dead plates without too much slope (which occasions difficulty in cleaning) were accommodated inside the door opening, and were supported by the blower tubes.

In working, as was to be expected, numerous difficulties were experienced. Coke breeze was fired from the start; and it was anticipated that the cooling action of the blast would to some extent counteract the effect of the fire on the large solid cast-iron grate. However, this was rather an over-estimate, as the grates buckled sadly and broke; and it was then decided to split the fire grates into three lateral sections. This was found to be an improvement, but the difficulty was not entirely overcome. At this point it will be interesting to note that coke breeze was successfully burned from the first at a rate of 30 lbs. per sq. ft. of grate area per hour; the moisture content of the fuel in most cases exceeding 10 p.ct.

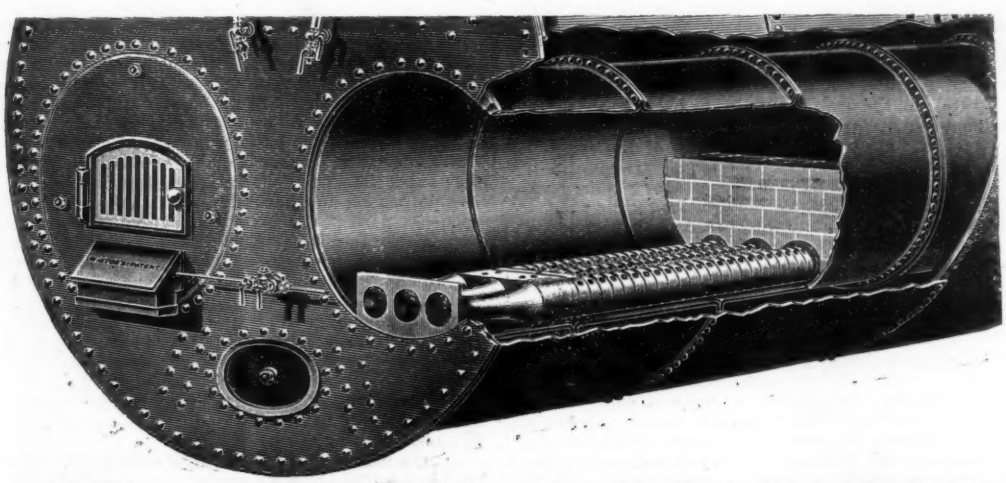
The Pre-1920 Wilton Grate.

It was soon found that owing to the imperfect design of the grate itself a sectional grate would be required; and therefore, while retaining the original shape of the grate instead of splitting it into three lateral sections, the lateral type of firebar was evolved, giving the first sectional grate and retaining the longitudinal circular air passages as in the original design. These first lateral sections (known as the ring type) were 2½ in. wide, which dimension was adhered to up to the year 1920. It was then found that the grate retained its shape under all conditions, and (as previously stated), sitting as it does right in the bottom of the furnace tube, took full advantage of the additional heating surface thus gained, and this at a point in direct contact with the fire itself. In addition, it became evident that, owing to the peculiar position of the grate, there was little or no possibility of damaging the crown of the furnace tube with the fierce heat from the forced draught grate—a point which caused great perturbation to the Boiler Insurance Companies, and which the Wilton grate overcame. Numerous installations were made of this old ring-type furnace, and many are working and giving satisfaction to this day. One range of boilers in the East End of London has still some of the original bars working, after having been in use over a period of more than 25 years.

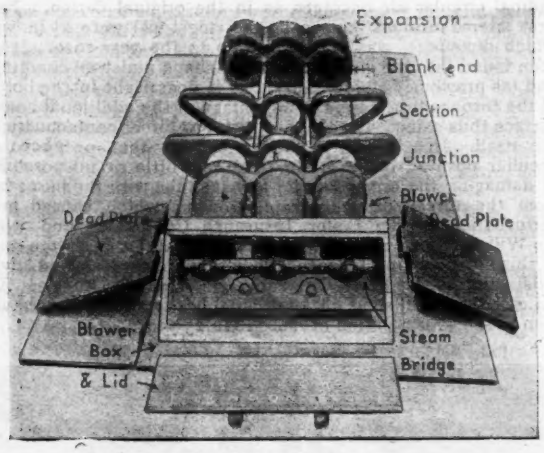


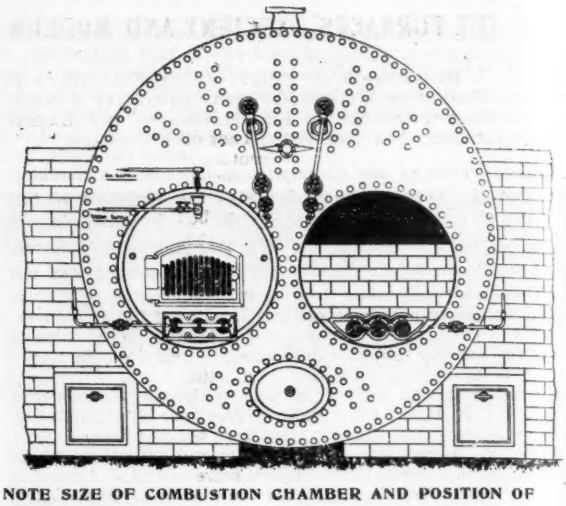
Wilton's Patent Furnaces (Ring Type) Fitted to Lancashire Boilers and Burning Refuse over Twenty Years ago.

One disadvantage which became apparent at this period was that the ends of the bars being circular in shape at the point of contact with the furnace tube allowed of a collection of dust and ashes, and the formation of a dead spot along the edges of the fire. This was overcome by the adoption of the wing type of bar, which (killing two birds with one stone) did away with the two dead spots on the edges of the fire, and greatly increased the grate area without in any way affecting the position of the furnace in the tube. At the same time, as these improvements were being effected, a careful watch was kept on the design of the blowing arrangements, to which many improvements were added from time to time. To such an extent was this the case that when burning coke breeze, with sympathetic use, the total steam used did not exceed 3 p.ct. of that generated by the boiler, and coke breeze, from being valueless, became enhanced in price when it was found that it had a market for steam-raising purposes. As proof of perfect combustion and highest efficiency, the following table of flue gas analysis, taken on a range of boilers fitted with this type of furnace, shows that for the class of fuel used great strides had been made in the efficient burning of what was previously waste; and far from being a low-grade fuel, coke breeze became



1st STAGE—WILTON'S PATENT FURNACE (RING TYPE)—THE FIRST SECTIONAL TYPE STEAM-JET FORCED-DRAUGHT FURNACE WITH INDEPENDENT LONGITUDINAL AIRWAYS.





2nd STAGE—WILTON'S PATENT FURNACE (WING TYPE). NOTE SIZE OF COMBUSTION CHAMBER AND POSITION OF GRATE IN FURNACE TUBE.

a good-class fuel—a factor taken into consideration by every gas engineer before he disposed of even small quantities.

Table of Flue Gas Tests.

As testimony to the efficiency of this development of the Wilton grate, 10,000 installations were made in the British Isles alone; while in other parts of the world a further 15,000 installations were effected. It is of interest at this point to remark on the numbers of similarly designed furnaces which made their appearance on the market during this period, and to the numerous uses, other than burning solely coke breeze, to which this furnace has been put. All types of boilers were then being fitted, and waste dumps of collieries had become a fruitful source of supply of low-grade fuel for burning in the Wilton grates.

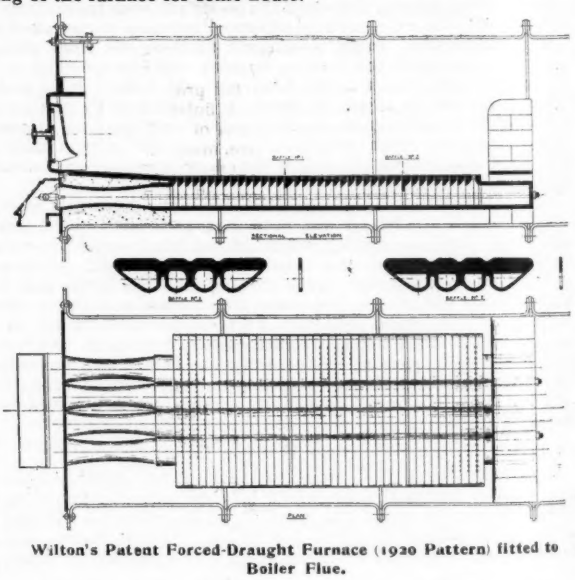
Flue Gas Tests Taken on Range of Lancashire Boilers fitted with Wilton's Patent Forced-Draught Furnaces.

Boiler No.	Fuel.	Steam on Blowers.	CO_2.	O_2.	CO.	Boiler at Work after Cleaning.
12	Coke breeze	Full	17·4	2·6	*Nil*	1 week.
13	,,	,,	16·8	3·0	*Nil*	2 weeks.
14	,,	,,	16·8	2·6	*Nil*	4 weeks.
15	,,	,,	16·8	3·2	0·6	6 weeks.
16	,,	,,	16·4	2·4	0·6	3 weeks.
17	,,	,,	17·2	2·2	*Nil*	1 week.
18	,,	,,	16·8	2 2	0·8	1 week.
19	,,	,,	16·4	2·8	0·4	2 weeks.
20	,,	,,	16·6	3·4	*Nil*	5 weeks.
21	,,	,,	16·4	3·6	*Nil*	1 week.
22	,,	,,	17·8	2·4	*Nil*	1 week.
23	,,	,,	17·0	3·0	*Nil*	5 weeks.
24	,,	Half turn	15·4	3·8	0·4	3 weeks.
		Average .	16·7	2·8	0·2	

During the course of the development of the grate as outlined above, it became apparent that even better results could be obtained, as, up to this stage, the draught as produced by the steam jets gradually mounted to a higher pressure at the back of the grate than at the front end. This was caused by the pressure meeting a blank end, and eddying back to such an extent that, 18 in. in front of the fire bridge, there existed a period of high pressure greater than at any other part of the grate. Tests were made on several lines to overcome this; among others, the tapering of the longitudinal airways. But this method was discarded, owing to the increased expense and difficulty in keeping these airways free from fine dust, which is bound to find its way into them from the surface of the grate. These airways being smaller at the back of the grate, and the air current always being in that direction, this method was discarded, owing to there being no way of keeping the small end clean from the front end of the grate. A further difficulty in connection with the unequal pressure in the longitudinal airways was that this higher pressure required very careful stoking to combat. If the fire was not carefully watched, a very fierce combustion right on the bars themselves at the point of highest pressure caused the firebars to burn out quicker than they would in ordinary circumstances, and the question of cost of replacements became very pressing.

The 1920 Improved Patent Wilton's Forced-Draught Furnace.

In order to overcome these two pressing difficulties, experiments were carried out with the kind permission of Mr. D. F. Cross, of the Lea Bridge Gas-Works. In the first case, the bar has been redesigned so that a larger cooling area is exposed to the action of the air blast on its passage through them to the fire; and though this new type of bar is only 1½ in. wide, as against the old type 2½ in., the weight of metal in actual contact with the fire is exactly twice the weight in a similar position in the old type. Owing to this fact alone these bars are practically everlasting with ordinary use. The arrangement of air distribution in these bars has been altered; the air-flows being arranged on scientific lines, obviating any choking effects anywhere from the steam jets to the back end of the grate. The area of greatest activity experienced with the old types has been done away with by means of damper plates inserted at various points in the grate, determined after careful experiment. This method was adopted in preference to a gradually reduced cross-sectional area of the longitudinal airways, in order that the usual cleaning tools would still have a good free space to work in. Another point taken into consideration was the fact that should an accumulation of fine dust be allowed to collect in the airways, there would still be ample margin to prevent any serious interference with the efficient working of the furnace for some hours.



Wilton's Patent Forced-Draught Furnace (1920 Pattern) fitted to Boiler Flue.

With this new type of grate an even draught has been obtained over the whole grate area. Every class of low grade fuel can be burned economically and efficiently, at the same time maintaining the full output of the boiler plant. Some fuels—such as anthracite culm and rubbish—require much more burning than others. The Wilton furnace is specially designed for burning such fuels. The initial cost of the furnace is low, and it can be adapted to any class of boiler, and has many other applications. The exact quantity of steam required for producing the draught is superheated, and has been calculated and proved in order to render a perfect chemical combustion. The furnace will burn any class of fuel, from refuse upwards, thereby effecting considerable saving where the fuel normally used is good coal. In working, the boiler can be raised to its maximum output quickly and efficiently from a banked condition, thus rendering great assistance when dealing with peak loads. When burning non-volatile fuels, the grate is smokeless, but smoke-consuming apparatus can be fitted for burning bituminous fine slack and other smoky low-grade fuels. When fitted to Lancashire and Cornish boilers, the fact that the grate lies on the bottom of the furnace tubes gives an advantage in heating surface, and also renders damage to the furnace crown impossible.

In conclusion, thirty-five years' experience, experiment, and good and faithful pioneer service have resulted in the production of a grate second to none when it is desired to raise steam from what was once called "any old rubbish."

COMMERCIALLY PURE IRON.

THE perfection of commercially pure "Armco" ingot iron is a research accomplishment—an achievement primarily designed to reduce the growing and serious expense of rust. Metallurgists and chemists pointed out the way. They experimented, studied, and investigated. They analyzed century-old irons, seeking the reasons for such longevity and resistance to the natural causes of corrosion. The problem was: "How can the life of iron be increased?" The answer was found to be: "Produce an iron free from segregated and rust-inviting impurities."

The producer of commercially pure iron has to rely on the analyst, whose work may be divided into three general groups: Investigation of raw materials; activities necessary for complete chemical control of the material during manufacture and analysis of the iron when made; and a study of the corrosive conditions to which the finished iron is subjected.

It is not within the scope of a short article to give a detailed description of the process of manufacture; but it may be well to state that the production of ingot iron involves more careful control from start to finish than is necessary with commercial steel as made to-day. There is the special selection of raw materials, the longer heating and higher temperature required to reduce impurities to an absolute minimum, the chemical control which

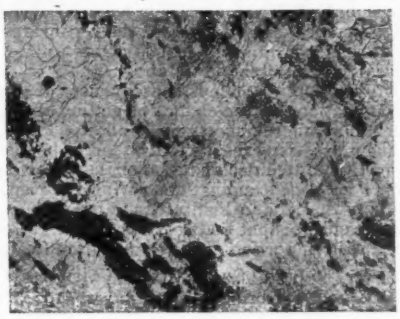


Fig. 1.—Charcoal Iron Magnified 70 Diameters.

calls for frequent metal tests during the progress of a heat and follows the metal until it becomes a finished product, the increased period of soaking pit and later of annealing treatment; all these factors, necessary as they are, mean that commercially pure iron made by the most up-to-date methods cannot be offered for sale at the same price as steel. The cost of the material, however, is sufficiently competitive to attract the favourable consideration of thinking buyers who regard service life and saving in maintenance costs as important as initial expenditure.

There are many examples of irons made centuries ago which have stood the test of time, and are found to-day in sound condition. Probably the best known is the iron pillar at Delhi which has stood for fifteen centuries, samples of which were analyzed by Sir Robert Hadfield some years ago, and found to contain 99·72 p.ct. pure iron. Coming to more recent history, many gas engineers can still point to examples of the old irons made forty and fifty years ago, which are still serviceable. These old charcoal irons ran high in phosphorus and silicon, owing to their process of manufacture, but were low in the essential elements of manganese, sulphur, and carbon.

The analysis of "Armco" ingot iron, it is claimed, is superior to the old iron, good as it was; and furthermore the metal is offered for sale under a definite guarantee of purity reading "99·84 p.ct. pure iron by difference, considering not only the silicon, sulphur, phosphorus, carbon, copper, and manganese, but also the gases oxygen, hydrogen, and nitrogen." It is also necessary to mention that ingot iron is free from slag inclusions, which are of necessity inseparable from all puddled irons.

The evidence of micro-photography confirms the statements made in the foregoing paragraphs. The large black marks in the charcoal iron (fig. 1) indicate the presence of slag in the material. The black spots and muddy substances in the steel (fig. 3) reveal impurities and blowholes, while the almost pure ferrite structure of ingot iron is clearly shown in fig. 2.

Perhaps the most interesting and diversified activity of the research investigator is the study of the corrosion problem, and the securing of data which show the service life of commercially pure iron in comparison with ordinary irons and steels when these metals are subjected to the many uses for which ferrous metals are demanded. Such investigations have been carried out during the past fifteen to twenty years; and the results obtained firmly establish commercially pure iron as the most rust-resisting iron procurable to-day on a competitive basis. As an example, the photograph (fig. 4) shows the results of a practical laboratory in-

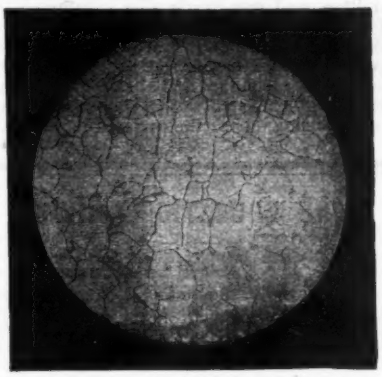


Fig. 2.—"Armco" Ingot Iron Magnified 70 Diameters.

Fig. 3.—Open-Hearth Steel Magnified 70 Diameters.

vestigation. The saucer-shaped receptacles were originally identical in size and gauge. These saucers were filled with locomotive cinders saturated with 3 p.ct. sodium chloride (common salt) solution. The contents of the saucers were kept moist by the addition of distilled water. The test was conducted for 157 days; the testing conditions being exactly the same for all specimens. The marked differences in corrosion-resisting properties are apparent. Saucer "A" is "Armco" ingot iron, whereas saucer "B" is charcoal iron, and saucer "C" is common steel.

From a physical standpoint "Armco" ingot iron is a dense metal with great toughness and ductility, having a tensile strength of from 18 to 21 tons per square inch, with a yield point of approximately 65 p.ct. of the tensile. It has consequently very good working properties; and owing to its purity and uniformity, it can be welded with ease and certainty. In common with all pure irons, there is a critical range of temperatures in which the metal should not be worked. In "Armco" ingot iron the critical zone ranges from 800° to 1000° C.

The gas engineer is constantly experiencing trouble and anxiety due to the ravages of rust and corrosion. In some localities it

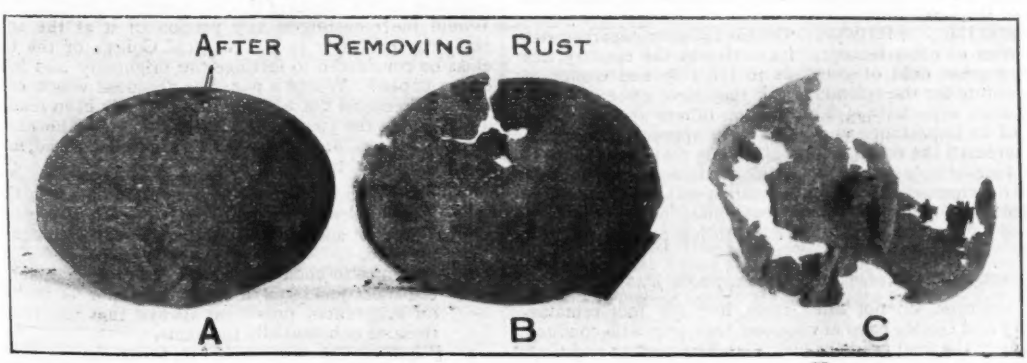


Fig. 4.—A Practical Test for Corrosion Resistance.

is not uncommon to find pit-holes in steel gasholders which as an expedient have had to be stopped up with bolts and nuts. By the adoption of commercially pure iron, tubercular corrosion of this description would be eliminated. In this connection, the fine paint-holding surface of ingot iron should be an added argument to its adoption for gasholder construction.

The same properties of purity and uniformity can be utilized to advantage in the manufacture of gas-meters both large and small, especially in localities and under conditions where premature corrosion is to be anticipated. The makers offer for this purpose an alloy-coated sheet, which consists of the commercially pure iron base, and a coating essentially of lead and tin in the proportion of about 88 p.ct. lead and 12 p.ct. tin. This sheet some time ago received the attention of the Life of Gas-Meters Joint Committee, and was favourably mentioned in the report published in the "Gas Journal" on Aug. 17, 1921.

The superiority of "Armco" ingot iron, when galvanized, over other galvanized ferrous metals can be explained—not only by reference to the rust resistance and absence of pitting in the pure iron base metal, and the tight adherence of the spelter coating which prevents peeling during the corrugating process, but by the fact that pure iron has less alloying tendency toward zinc than steel—thus insuring a purer spelter coating.

The following results of spelter coating analyses taken over a period of eight years, and representing the examination of over 500 different galvanized specimens, are interesting.

Material.	Percentage of Iron in Coating.
Commercially pure iron	3·92
Impure coppered iron	4·89
Common steel	5·91
Coppered steel	4·55

The manufacture of ingot iron under the patents owned by the International Metal Products Company has been extensively undertaken in the United States since the process was discovered. It was introduced into this country just prior to the war, and is now manufactured under licence by four well-known British companies in the form of sectional material, heavy hot-rolled plates, lap and butt welded tubes, wire, and welding rods. The sale of sheets in the various grades produced is undertaken by the American makers through their British representatives.

THE EDUCATION SCHEME.

By Walter Hole.

Quietly, but successfully, the arrangements are being completed for the inauguration of the new Education Scheme of the Institution of Gas Engineers in various parts of the country; and among the means contributing to this end must be placed in a very prominent position the series of conferences of Junior Gas Associations now brought to a close. These have been arranged by every Junior Association in the country, and have been held in places as far apart as London in the South, Cardiff in the West, Glasgow in the North, with Accrington, Birmingham, and Bradford taking an honoured intermediate position.

Interested Junior Associations.

Held in vastly varying circumstances, all have had one thing in common, and that is a remarkably keen interest in the scheme itself and endeavour to elucidate points which appeared to be obscure or misunderstood. The bombardment of questions, pointed and pertinent as they have been, at the close of the principal address have proved beyond doubt a desire to work the scheme for all it may be worth. Not only has this been the case in connection with those who hope to profit personally by the scheme being put into operation, but those who have no such hope have desired fully to comprehend the scheme that they might be of assistance to others who may have been unable to get to the conferences. In this connection the desire to obtain a copy of the scheme itself has been expressed so often that the Advisory Committee have sent to the Secretary of each Junior Association a number of copies for the use of members, together with an intimation that if the number sent is insufficient more may be obtained on application. Any junior member, therefore, who wishes to obtain a copy may get one on application to the Secretary of his own association.

Guidance to Principals of Technical Institutes in Preparing Schemes.

In close connection with the foregoing is another matter in which information is being sought. Applications for suggestions as to desirable schemes are constantly being made by gas engineers up and down the country who have themselves been approached by the Principals of Technical Institutes or Directors of Technical Education in their districts. Full information on these points have been given to the Board of Education by one of their officials, who is also a member of the Advisory Committee for the guidance of Technical Colleges, in a pamphlet which has now been distributed to all engineers and managers of gas undertakings with a make of over 500 million c.ft. of gas per annum. Needless to say that anyone interested who does not come into that category may have one on application to Mr. W. T. Dunn, the Secretary of the Institution.

For the past thirty or forty years the gas industry, together with a great number of other technical industries in the country, has owed a very great debt of gratitude to the City and Guilds of London Institute for the splendid work they have done for technical education, especially at a time when others appeared less conscious of its importance and value. An appreciation of this debt has increased the regret felt on all hands that the inauguration of the Institution's own scheme, which is intended to broaden and deepen the channel of technical education within the industry, with the Institution itself as a final examining body, should be accompanied by any opposition or competition as between the two bodies.

Choice of Examinations in 1924; and Dates.

Regrets, however, do not alter facts, and the fact remains that the City and Guilds have announced that they will conduct examinations in the final grade of both Gas Engineering and Gas Supply in the spring of next year. In 1924, therefore, students will be able to choose whether they will sit for the examination under the City and Guilds scheme or under that of the Institution. This is bound to introduce some amount of confusion in the minds of the students; but when the confusion has passed away, and the comparative significance and value of the certificates gained has been fully grasped, we imagine that students will not be long in determining which examination to take.

In order to avoid the invidious consequences of students sitting for both examinations on the chance of getting through one—an option which in another connection was allowed for a time in Scotland with such disastrous results that it had to be discontinued—the Advisory Committee decided at their last meeting to accept the same date for their examinations as those advertised by the City and Guilds of London Institute. This has been done with the full concurrence of that body. These dates are, for all grades, including the written portion of the examination for the diploma:

Gas Supply . . . . May 3, 1924.
Gas Engineering . . . May 10, 1924.

The time for the ordinary and higher examinations will be from 2.30 to 6.30 p.m.; but the written portion of the Diploma Examination may probably occupy a longer time and be taken at two sittings. Of this, particulars will be given later.

In close connection with the above, some little misunderstanding has arisen as to the proper interpretation of the note at the end of the printed copy of the Institution's scheme respecting the admission, as a qualification for passing to higher divisions, of the City and Guilds certificates as equivalent to those of the Institution. The intention was clearly to make this altogether retrospective in character. In order, however, to avoid any possibility of hardship or injustice which might otherwise have been occasioned, it has now been decided to admit all such certificates gained at, or prior to, the examinations of May, 1924, to the operation of these clauses.

Extension of Time for Applications under Section II.

Last year only eleven Technical Institutes throughout the country included gas subjects in their ordinary curriculum, and even these were very unequally placed geographically. The consequence is, of course, that many students in various parts of the country are precluded from taking a co-ordinated gas course at such Institutes. These are provided for under Section II. of the scheme. The original date for the return of application forms to sit for examination was fixed as Aug. 31. Owing, however, to the delays incidental to the inauguration of the new scheme, it has been found impossible to adhere to that date, and it has now been extended to Oct. 15. Will intending applicants please note the alteration?

What is an Original Thesis?

Many questions have been asked as to what constitutes an original thesis as required for the diploma. Must it consist of original and independent research? Would a paper on, say, the gasholder, or the process of purification, be accepted? Would guidance in the choice of subject affect the question of originality? Would the recasting of any portion of it at the suggestion of (say) the professor at a Technical College or the teacher of a class be considered to infringe the originality and independence of the paper? Would a paper be accepted which conformed to the requirements but which had previously been read at a meeting of one of the Junior Gas Associations? The answers to all these questions, and others which have been asked, may be stated in a few general terms.

1.—The Committee would require proof that the thesis is the individual work of the candidate. There must be no possibility of suspicion that a paper has been bought for the purpose.

2.—Guidance in choice of subject is unobjectional, as is also the subsequent rewriting or redrafting of limited portions on suggestion, providing always that the redrafted part remains substantially the same.

3.—Whatever the subject chosen, the treatment of it must show independent thought and an application of the critical faculty. In the words of a university prospectus used in connection with another subject altogether, the paper must

"satisfy the examiners that it contains original work . . and that it is of a sufficient standard of merit. . ."

4.—No objection whatever would be made to any paper which has already been read before a Junior Gas Association being submitted for the satisfaction of this requirement. While not wishing to adopt any hard and fast rule, it is felt that for many reasons such papers should be submitted to the examiners first, and afterwards read, if desired, to junior or other associations.

Syllabuses for the Diploma Examination.

The syllabuses for the Diploma Examinations were also adopted at the last meeting of the Advisory Committee, and are given at the conclusion of this article. Applications to sit for this examination must be returned to the Organizing Secretary by Dec. 31 next, and, as has already been stated, the written portion will be taken on the same date as the corresponding subject in the lower grade. The thesis must be sent to the Organizing Secretary before the end of March, 1924, and the oral part of the examination will be taken about three weeks later than the written portion.

Age Limit.

Many do not yet appear to have grasped the significance of the age limit for the Diploma Examination, which has been fixed at a minimum of 23 years. The fact is being overlooked that the Diploma is intended to certify not only scientific and technical knowledge which might conceivably be purely academical in character, but also a personal acquaintance with, and thorough grip of, works routine and processes and a practical ability to deal with the emergencies which are continually arising on the works or district. This facility can only be acquired as a result of extended experience; and the age of 23 has therefore been fixed as the earliest at which such experience could possibly have accumulated. On the other hand, it was, of course, essential that the age limit should not be fixed so high as to interpose too long a period between what, for want of a better term, may be spoken of as student days; and so 23 has been adopted as a fair harmonization of the two.

It is a matter for regret that we are not yet able to publish a list of the Technical Institutes whose proposed gas courses have been approved by the Advisory Committee. In accordance with the scheme such proposed courses must be forwarded by Oct. 31 in any year. In view, however, of the difficulties incidental to the inauguration of any such new scheme, the Principals of Technical Institutes and the Directors of Technical Instruction were invited to expedite their proposals this year by forwarding them by Aug. 31. Unfortunately, most have found themselves unable to accept this invitation, and, consequently, we are compelled to wait a little longer before any such list can be issued.

Where the Student May Help.

Meanwhile, those who are awaiting so anxiously the publication of the list, may lend a helping hand. It is more than possible that some authorities are deliberately holding back until they can gauge the number of students upon whom they can rely. If, then, in the absence of public notification of gas courses, intending students will forward their name and address, together with particulars of the course they wish to take, to the Secretary of the Junior Gas Association for their district, and these, when collected, are forwarded to the Organizing Secretary, some steps may be taken to ensure classes being formed wherever the number of students would justify them.

The matter of granting of facilities for study and rewards for success in study has recently been ventilated in the columns of the "Journal." Evidence is steadily accumulating that the necessity for such is becoming increasingly recognized. Within the past few days further instances have come to hand. One gas company in the North has decided to refund all travelling expenses in the case of students making 75 p.ct. of the maximum number of attendances at class, and also to recoup his entrance and class fees to the student who secures 60 p.ct. of the highest possible number of marks for his homework. In another case, that of one of the largest undertakings in the country, the authorities have taken the drastic step of notifying their technical staff that in future advances in salary will only be considered in the cases of those who produce evidence of satisfactory progress in their technical studies. While such a rule may operate somewhat harshly in particular cases, it is evidence of a growing demand for the highest possible efficiency in the technical staff of the undertaking.

Syllabus for the Diploma Course in Gas Engineering.

In the final examination, questions will be set on the subjects specified in the syllabuses for the Ordinary and Higher Courses; but a more exact knowledge of, and experience in, the subjects will be required in the answers than in the previous courses.

For example, answers to questions involving a knowledge of physics and chemistry must show that the student not only possesses an advanced knowledge of the principles, but also of their particular application to the process under consideration.

Answers to engineering questions must show that the student possesses a detailed knowledge of the design and construction of all plant usually employed in gas manufacture, and that he has had experience in the working of such plant.

Syllabus for the Diploma Course in Gas Supply.

In the final examination more difficult questions will be set in the subjects named in the Higher Course syllabus, and in addition a knowledge will be required of:

Mains.—Flow of gas in mains, theory and practice. Main-laying costs in relation to prospective revenue, electrolysis and electric fusion.

General Lighting.—Theory of the incandescent mantle. Flame temperature. Flame propagation. Principles of illumination. Measurement of illumination both of interior and exterior lights. Combustion in its various forms.

Gas for Heating.—Furnaces for industrial use—theory and practice of construction. Refractory materials in connection therewith. Influence of and remedies for inconstant gaseous mixtures. Testing of temperatures. Working results. Testing of fires, cookers, and other appliances for thermal and hygienic efficiency.

Statutory Enactments, &c.—General legal obligations affecting gas supply. Factory and workshops Acts so far as they affect the use of gas. Relative fire risks of various methods of lighting and heating and the effect on insurance rates.

Important Developments of general interest in any matters relating to gas supply as have been fully described in the Technical Press.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Gasholder Construction and Design.

Sir,—I have read with much interest, in your issue of Sept. 12, the translation of the article by Herr Niemann which appeared in "Das Gas- und Wasserfach," in which he contrasts the design of the Sydney holder with the one erected at East Greenwich. He asks the reason why the Sydney holder was not designed with a system of reduced guide-framing. This system has not found much favour among gas engineers in this or any other country, as the saving effected does not compensate for the extra cost of maintenance. The shortening of the framing considerably increases the wear and tear on the carriages and axles of the guided lifts, as well as on the cups and dips of the flying lifts; and it is very probable that some of the gasholders which were originally constructed with flying lifts will have the guide-framing extended to the full height in the near future. A reduced guide-framing can, of course, be made strong enough to withstand the distorting force of the wind, but flying lifts are subject to an accumulation of stresses due to vibration caused by repeated shocks from the wind. These shocks may succeed each other with considerable frequency, setting up local strains in the cups and dips of the flying lifts, and increasing the pressure on the guide rollers in the framing.

The guide-framing with stiff diagonal bracing and only one tier of top girders may present a pleasing appearance; but I do not consider it can be made as stiff and rigid as the type adopted for the Sydney holder, unless the diagonals are constructed as girders with angles or tees strongly braced together with lattice bars—similar to the design adopted by Messrs. S. Cutler & Sons, Ltd., in what they term their "triangulated" system of framing, where the diagonals are designed to resist both tensional and compressive strains. It is doubtful, however, whether this type of construction would prove economical in the case of a gasholder of so large a capacity as the one at Sydney.

Herr Niemann wonders why no attempt has been made by English gasholder makers to standardize their designs. Standardization, in my opinion, is neither possible nor advisable with the ordinary type of guide-framed gasholder. Local conditions and circumstances will always control the depth and diameter of the tank; furthermore, varying climatic and site conditions both necessitate and justify wide differences in design. What is suitable for a London works may be out of place at the Antipodes; and with conditions so diverse, standardization would be a positive danger.

The "tankless" type of gasholder, however, which seems likely to become a rival to the older systems, may bring us nearer to uniformity of design, as it eliminates both the guide-framing and the water seals, leaving only parts that can well be standardized over a wide range of capacities and other conditions.

As mentioned in my article on the Sydney gasholder, the invitation to submit designs and tenders specified the guide-framing to be carried up to the full height of the holder when all the lifts were inflated; and I must say that past and present experience confirms the wisdom of the Australian Gas Light Company's Engineer in making this definite stipulation, particularly when consideration is given to the very high winds prevailing in Sydney, and the site being thousands of miles away from the place of manufacture. In fact, the conditions obtaining at East Greenwich and Sydney are so divergent that there seems little advantage in contrasting the construction of the two holders.

The figures in the sixth column of Herr Niemann's second tabulated statement are obviously incorrect, and should presumably be inverted.

In conclusion, it may be mentioned that the Sydney holder has been working to its full capacity ever since the first day it was brought into commission, without difficulty of any kind. This at least seems some justification for the design.

R. J. Milbourne.

Lilleshall Old Hall, nr. Newport-Salop,
Sept. 25, 1923.

Broadcasting Gas.

Sir,—During the course of the wireless concert from "2 L.O," last evening, a talk upon "The Electrical Engineering Industry" was given by Mr. Hugo Hirst, the Chairman of the General Electric Company, which was of a most interesting nature. A great deal of information was given as to the use of electricity for lighting, cooking, power, and general industrial and domestic purposes, and the note of optimism struck by the speaker relative to the future was notable for its sincerity. An invisible audience of at least 100,000 "listeners-in" must have heard the address; and doubtless many were impressed by the information given.

Having regard to the importance of the use of gas for multifarious purposes connected with the home and industry generally, from econo-

mic, coal-conserving, and utilitarian aspects, it would seem desirable that the gas industry should make arrangements for the broadcasting of an address upon gas, its use, value, and utility, by some person of eminence in the profession.

The value of such publicity would be very great, and doubtless the Broadcasting Company would be prepared to adopt any suggestion that might be made.

Samuel B. Chandler.

Tottenham District Light, Heat, and Power Company,
No. 639, High Road, Tottenham, N. 17, Sept. 27, 1923.

Private Oxygen Plants.

Sir,—On the 24th inst., our Secretary wrote to you with reference to the effect of competition on the price of oxygen. His letter was inspired by one published in your issue of the 19th inst. [p. 872] from Mr. O. Simonis, of Liquid Air, Ltd.

We have now received from our news agency what I assume to be an editorial article from your Journal bearing the same date. In this article you make it obvious that you accept the opinion expressed by Mr. Simonis, which, as far as I can remember (I have not the letter by me), was to the effect that no man who knew anything about liquid-air plants would dream of running them intermittently. I claim to know something about such plants, and I do not hesitate to say that it is the reverse of economy to run a small plant day and night to produce 25,000 c.ft. of oxygen per week. The whole trend of modern investigation, so far as small plants are concerned, is to construct an apparatus which can be rapidly cooled to the air-liquefying temperature, and I could show Mr. Simonis plant manufactured recently by this Company which would probably astonish him by the rapidity with which its temperatures are lowered. Furthermore, I have seen abroad fairly large liquid-air plants of modern design which I was told were worked only during the day, as in the long run that was found to be the safest and most economical method.

The British Oxygen Company, Ltd.,
K. S. Murray,
Managing Director.

Angel Road, Upper Edmonton, N. 18,
Sept. 27, 1923.

THE PATENT INJECTOR-VENTILATOR FOR GAS-FIRES.

An Apology for Infringement.

The following letter—constituting an apology for an infringement of the patent injector-ventilating fitting of Radiation, Ltd.—has appeared in the Sydney (Australia) "Morning Herald" and "Daily Telegraph" of July 14 this year:

Dear Sirs,—In consideration of your kindly agreeing not to take proceedings against "K.F.B." Foundry, Ltd., in respect of our infringement of the patent "Injector-Ventilator" fitting to gas-fires patented in Australia by Harry James Yates, of Birmingham, England, under No. 14,205/14, dated 17th August, 1914, which patent we hereby admit having copied and infringed in the "Alpha" gas-fire of our manufacture, we hereby tender to the patentee and all concerned our apologies and regrets for having infringed this patent. We also undertake to cease manufacturing or vending this gas-fire or any other gas-fire embodying this patent, to destroy immediately all patterns and gas-fires which infringe this patent, and which we have in stock in our possession or on consignment with any of our agents or customers, to pay you damages as arranged, and at no future date to infringe your patents or copy any of your registered designs in connection with gas cooking, heating, or water heating apparatus or any other appliances manufactured by you or any other firm in Radiation, Ltd. We authorize you to make what use you wish of this letter. —Yours faithfully,

"K.F.B." Foundry, Ltd.
(Signed) J. P. Wiatt,
Acting Managing Director.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Sept. 26.]

Nos. 23,181 to 23,760.

Allaway, G. A.—"Manufacture of gas-nozzles for boiling burners, &c." No. 23,408.

Badische Anilin- and Soda-Fabrik.—"Manufacture of fuel gas." No. 23,232.

Bergh, S. V.—"Retort furnaces for treating bituminous materials." No. 23,345.

Helps, G.—"Gas cookers and hotplates." No. 23,205.

Helps, G.—"Instruments for testing gas flames." No. 23,582.

Helps, G.—"Gas-burners." No. 23,583.

Johnson. J. Y.—See Badische Anilin- and Soda-Fabrik. No. 23,232.

Jones, F. W. S.—"Distillation of coal, &c." Nos. 23,572, 23,573, and 23,574.

Leech, S.—"Street-lighting lanterns." No. 23,467.

Neath, J.—"Manufacture of gases for heating, illuminating, &c." No. 23 220.

Nelson, A. & T. B.—"Furnaces or burners for cooking." No. 23,736.

Olivier, G. P.—"Gas fires, ovens, &c." No. 23,596.

Parker, C. H.—See Jones, F. W. S. Nos. 23,572, 23,573, 23,574.

Parsons, G. H. & H.—"Gas cooker shield." No. 23,483.

Schaar, E. G. Björnsen.—"Manufacture of benzole products and coke." No. 23,264.

Stewart, J. G.—"Gas calorimeters." No. 23,201.

Ulli, A.—"Gas-stoves." No. 23,508.

MISCELLANEOUS NEWS.

GAS REGULATION ACT APPLICATIONS.

The following further notices have appeared in the "London Gazette" with regard to applications to the Board of Trade for Orders under the Gas Regulation Act.

Portmadoc Urban District Council.

The maximum price now authorized in respect of the supply of gas by the undertakers is 5s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 6·67d. per therm.

It is also proposed that an additional charge of 3d. per therm should be authorized in respect of gas supplied through a prepayment meter.

SPECIAL ORDERS.

Accrington District Gas and Water Board.

Application is to be made by the Board for a Special Order under section 10 of the Act to extend the limits of gas supply so as to include the parish or township of Whalley and a portion of the parish or township of Billington, and to detach this part of Billington from the limits of gas supply of the Blackburn Corporation; to prescribe gas prices in the extended area; to empower the Board to acquire the undertaking of the Whalley Gas Light Company; to enable them to secure additional land for gas purposes; to regulate the supply of gas; and to authorize the borrowing of further money.

Wirksworth Gas Light and Coke Company, Ltd.

The Company are applying for a Special Order to authorize them to use scheduled land for gas purposes; to supply gas within the urban district of Wirksworth and the parish of Middleton-by-Wirksworth; to make provision as to the capital of the Company; to prescribe gas prices and dividends; to regulate the supply of gas; and for other purposes.

DECLARATIONS OF CALORIFIC POWER.

Coalville Urban District Council.—520 B.Th.U. (Oct. 1.)
East Cowes Gas Company.—475 B.Th.U. (Dec. 28)
Golborne Gas Company.—500 B.Th.U. (Sept. 29.)
Woodhall Spa Gas and Water Company.—500 B.Th.U. (Oct. 1.)

GLASGOW—SMOKELESS FUEL AND LOW-GRADE GAS.

The Former for Domestic Purposes and the Latter for Electricity Generation.

Since December, 1921, a Sub-Committee of the Gas Committee of the Glasgow Corporation have had under consideration the question of the production of a smokeless fuel for the citizens, by a low-temperature carbonization system, and at the same time the supply of a low-grade gas to the Electricity Department for firing boilers at their new generating station at Dalmarnock. After many meetings and much investigation (including estimates for plants and working expenditure and results by Low Temperature Carbonization, Ltd., Maclaurin Carbonization, Ltd., and Low Temperature and Tully Gas Plants), the Gas Committee decided to recommend the Council to erect a five-unit battery of Maclaurin producers. The City Council have approved of this. The new electricity generating station, by the way, is situated about half-a-mile from the Dalmarnock station of the Gas Department, where the new plant will probably be located.

A Report by Mr. M'Lusky.

In view of the decision to proceed with the scheme, it will be of interest to reproduce a report on the subject of the Maclaurin plant at Grangemouth, prepared by Mr. John W. M'Lusky, the Engineer and General Manager of the Gas Department, and submitted to the Committee early last year. The report was as follows:

The plant is compact, easily manipulated in a comparatively small site, and free from any complicated machinery. It could easily be designed as an independent unit, raising its own steam, generating its own electricity, or driving its own gas-engines. The adaptation of temperatures in the producer to secure a large volume of low-grade gas and a good quality of coke is very skilfully carried out, with the minimum expenditure.

The plant should make a strong appeal to important industrial concerns where there is a demand for large volumes of low-grade gas (say, from 175 to 250 B.Th.U. per cubic foot), and where a profitable use could be made of the resultant solid fuel.

It must be borne in mind that any ordinary gas-works plant using horizontal or vertical retorts (and particularly the latter) can produce an excellent smokeless fuel, provided the management is able to confine the selection of coal to the best coking seams.

In the test under consideration, the coal used was Carron Lower Coxrod coal, a well-screened lustrous coking coal, containing 70 p.ct. large lumps, giving the undernoted analysis:

	P.Ct.
Moisture	5·48
Volatile matter	29·72
Fixed carbon	55·28
Ash	9·52
	100·00

Sulphur, 1·61 p.ct.

The plant being designed primarily to produce smokeless fuel, the best coals for that purpose would naturally be selected. The demand for and sale of the fuel would entirely depend upon public opinion; and to secure extensive patronage the fuel would require to be useful in the kitchen range for the supply of domestic hot water.

The gas supply, being unsuitable as a diluent in town gas, would

require separate distributing mains for industrial purposes, such as gas-engines, steam-raising, metal-melting, and many other purposes in specially designed furnaces.

The design of the plant introduces a very large percentage of nitrogen in the gas as compared with ordinary town gas for domestic purposes, as follows:

	Nitrogen. P.Ct.	Calorific Value. B.Th.U.
Four days' test, Grangemouth	50	247
Town gas, using only Woodall-Duckham verticals, 18,000 c.ft. per ton	7	400
Town gas, using only Glover-West verticals, 18,000 c.ft. per ton.	6	400
Glasgow gas—verticals, horizontals, and water gas	6	490

Even in very small quantities the Maclaurin gas as a diluent in town gas would give trouble in blending, owing to the difference in specific gravity. It must, therefore, be ruled-out as a proposition for domestic appliances as in use at the present time.

Taking the probable expenditure for running the plant, and all other charges, and allowing for revenue on bye-products, the gas could be set down at 2·32d. per therm to make financial ends meet. In order to make it clear to the Sub-Committee, 2·32d. per therm, converted into cubic feet, would equal 5·73d. per 1000 c.ft. of 247 B.Th.U. gas. Such figures prove that the gas would be attractive financially for the purposes previously mentioned.

Estimate of Capital Cost and Working of a Five-Unit Maclaurin Plant.

Further interest will be found in the latest estimate submitted by Maclaurin Carbonization, Ltd., as to the capital cost, &c., of working a five-unit plant.

5-Unit Maclaurin Plant, Capacity 100 Tons per Twenty-Four Hours of 250 Days.

Capital cost of plant (detailed)—		
Five retorts	£8305	
Condensers	500	
Pressure and suction fans	70	
Oil and ammonia scrubbers	1500	
Pumps, pipes, and erecting	410	
Coal elevators and conveyors	900	
Motors for same	500	
Mains and tubing	300	
		£12,485
Coke screens and motor for same	£450	
Storage bunkers and tanks	3000	
Electric wiring	150	
Buildings	1000	
		4,600
Contingencies, including boilers if required	£2915	2,915
		£20,000
Daily throughput		100 tons.

	Expenditure per Annum.	Revenue per Annum.
Cost of 25,000 tons of coal carbonized at a throughput of 100 tons per day for 250 days per annum, with coal at £1 per ton.	£25,000	
Working Costs—		
Labour—2s. per ton £2500		
Management and Laboratory, at 7·2d. per ton 750		
Steam at 6d. per ton 625		
	£3,875	
Producer gas not required.		
Depreciation and upkeep at 15 p.ct. on £20,000	3,000	
Interest on capital at 5 p.ct.	1,000	
Rent, rates, taxes, and insurance	1,000	
Royalty at 2d. per ton	208	
General charges	750	
Stores	500	
Electric power	944	
Oil—15·6 gallons per ton at 4d.		£6,510
Sulphate of ammonia—17·3 lbs. per ton at ¼d.		887
Gas—68·4 therms per ton at 1·32d. (247 B.Th.U. per cubic foot), say		9,358
Fuel—Large, 8·05 cwt. Medium, 1·15 cwt. Breeze, 1·75 cwt.		
10·96 cwt. per ton = 13,700 tons per annum, at 28s. 6d. per ton		19,522
	£36,277	£36,277

N.B.—68·4 therms = 1,710,000 therms per annum, at 1·32d. per therm.

Burgess Hill Gas Company.—An extraordinary meeting of the Burgess Hill and St. John's Common Gas Company was held on Sept. 20—Lieut.-Col. S. T. Maynard, J.P., presiding. The Chairman said the meeting was called with the object of complying with the statutory requirements before the Company would be in a position to introduce further debentures in respect of the preference shares issued last year. They were entitled to raise debentures to the extent of one-third of the capital in preference or ordinary shares. They had obtained the sanction of the shareholders for the issue of debentures for capital previously raised; and they now asked sanction to raise an additional £850 in respect of the £2500 preference shares issued last year. To avoid the necessity of calling the shareholders together again, they asked for similar sanction in respect of any further preference or ordinary shares which might be issued. A resolution giving the required sanction was passed.

BRITISH GAS LIGHT COMPANY, LTD.

The Annual General Meeting of the Company was held on Wednesday last, at the London Offices, No. 2, The Abbey Garden, Westminster—Mr. Henry Woodall in the chair.

The report of the Directors and the statement of accounts for the year ended June 30 were taken as read.

Satisfactory Statement of Affairs.

The Chairman, in proposing the adoption of the report and accounts, said: We have again to put before you what I think you will all agree is a satisfactory statement of our affairs. You will be pleased to hear that my remarks to-day will be very short, as there is no longer any need to dwell on the question of therms, and the negotiations with the Corporation of Stoke-on-Trent are now past history. When we had the pleasure of meeting you last year, I mentioned that the Trowbridge and Holywell stations showed a loss on the working, but that the Directors hoped that the result of the new Order would be satisfactory. I am glad to say that our anticipation has been justified, and that instead of a loss both stations have shown a substantial profit; at the larger one, Trowbridge, the full parliamentary interest has been earned.

Decrease in Gas Sold.

As you will have noticed from the report, the quantity of gas sold for the year shows a decrease of 3·24 p.ct. This is, however, hardly to be wondered at when one remembers the large amount of unemployment there has been throughout the country; and this has been felt severely at both Hull and Norwich—our two most important stations. Although the net profit for the year ended June 30 is £19,000 less than that of last year, an analysis of the accounts of the two principal stations will provide a satisfactory explanation.

Hull Station.

At Hull the profit last year amounted to £69,679, of which £19,028 was transferred to the Hull reserve fund, leaving £50,651 to the credit of profit and loss. This year the profit amounted to £78,988, of which £36,300 was transferred to the reserve fund, leaving £42,688 to the credit of profit and loss—a reduction of £8000. Last year we were able to bring into the general account a larger portion of the Hull profits, because at that time there were some back dividends due from the station. The Hull reserve fund now amounts to the substantial sum of £56,260, which is available for the equalization of profits at that station.

Cost of Alterations and Extensions at the Palace Works.

I referred last year to the large expenditure incurred at Norwich upon alterations and extensions at the Palace Works. The major portion of this work is now practically completed, the cost to date amounting to £236,159. It is necessary that a portion of this sum, representing renewals and the cost of displaced works, should be charged against the revenue of the station—the total revenue charge is approximately £80,000. As soon as the new work was put in hand the Directors commenced to provide for this by writing certain sums off profits periodically. In the year ended June, 1922, the sum of £12,000 was so written-off; but in the year to June, 1923 (the year under review), the amount was £27,700, thereby reducing the Norwich revenue by some £16,000 more than was the case last year. The total written-off to date amounts to £50,000, thus leaving the sum of £30,000 to be provided out of future profits. You will, I am confident, approve the policy we have adopted at Norwich. It was unfortunate that we had to make large alterations and additions at the station at a time when prices of all material and labour were at their highest. The result is that the capital is high, and consequently the price of gas is greater than we like to see it. The only way to lower this price is to reduce as far as possible the charge for capital, at the same time increasing our output. The sales are now on the upward grade, and the extension we made to Wroxham is helping in this direction.

Repairs at Yarmouth Chemical Works.

The profit at the Yarmouth Chemical works is always a fluctuating one. The reason that it is not as good as usual this year is that there have been some rather heavy repairs, and that the price paid for the tar distilled at the tar works has been high. But this high price has been an advantage to the Norwich works, as the tar distilled at Yarmouth is supplied by the Norwich station.

Price Reduced at Hull.

The Order under section 1 of the Gas Regulation Act was made by the Board of Trade on April 30, and since June 30 last gas has been sold at Hull on the therm basis. In view of the satisfactory reserve fund at the station, the Directors have been able to reduce the price of gas as from Oct. 1 to 8d. per therm, which is equivalent to 3s. 0·8d. per 1000 c.ft. The price charged during the year to June, 1923, was 4s. per 1000 c.ft. for a period of three months, and 3s. 6d. for nine months of the year. The present price (8d. per therm) is a reasonable one, but we hope to do even better later. We are slightly below the neighbouring East Hull Company. The new showrooms are not yet completed, but we were able to move into a portion of the premises at the end of June. They have already attracted considerable attention; and the Directors feel sure that when they are finished they will be one of the most up-to-date showrooms in the country.

Retirement of Mr. Warren.

Mr. Warren, who has been with us for fifty years and most ably looked after our distribution system at Hull during that period, has retired this year. The Directors have given him a suitable retiring allowance, and Mr. Warren has received testimonials from his colleagues and from the Directors showing their high appreciation of his long and faithful services.

The Norwich Station.

At an extraordinary meeting held on Feb. 21 last the shareholders approved the draft of a Special Order empowering the Company to expend additional capital on the Norwich station. The Order was made by the Board of Trade on April 14, under which the Company

are authorized to expend for the purposes of the Norwich undertaking a further sum of £300,000 in addition to the £625,000 already authorized under the Company's Special Acts. The capital should now be sufficient for the needs of the station for many years to come, especially as we are going to wipe-off as much as we can out of revenue. We have recently purchased some premises in Magdalen Road, Norwich, which will shortly be opened as an additional district showroom. In view of the somewhat heavy revenue charges to which I have already alluded, the Directors have only been able to make a small reduction in the price of gas; but they trust that the economies which are being effected by the introduction of new plant will shortly enable them to announce a further reduction.

THE TROWBRIDGE STATION.

With the view of stimulating business, we have recently acquired some premises in one of the principal streets of the town which will, in due course, be opened as a showroom. The Directors have been glad to be able to make a reduction in the price of gas at this station, which took effect on April 1 last.

THE POTTERIES UNDERTAKING—INVESTMENT OF PURCHASE MONEY.

The purchase of this undertaking was completed on Dec. 8 last, when the Corporation of Stoke-on-Trent handed over the final payment due to the Company, which amounted to £60,978. With regard to the investment of the purchase money of the undertaking, the position at June 30 last was that approximately half of the amount was invested in the Company's other stations, where it is earning an average interest of 7 p.ct., whereas the average rate of interest authorized on capital expenditure at the Potteries was about 6½ p.ct. The remainder of the money was invested in 5 p.ct. National War Bonds (bringing in interest at the rate of about 4¾ p.ct.) until such time as it is required for the business of the Company. To-day the amount so invested is £126,940. A number of properties have been put before us, but you may be sure your Directors will be very careful as to their investment of the balance of the money received from the sale of the Potteries undertaking.

A SOUND INVESTMENT AT SWANAGE.

As I told you in September last year, we have obtained a controlling interest in the Swanage Gas Company. This investment will, we are satisfied, be a profitable one. The Swanage Gas Company have now acquired the electric light undertaking at Swanage, and there is little doubt that the combination of the two concerns will be an advantage to the town as well as to the Company. This undertaking is one in which our investment will no doubt increase.

CONVERSION OF SHARES TO STOCK.

Since the last general meeting each £20 ordinary share has, as you are aware, been divided into two ordinary shares of £10 each, and one additional share has been allotted in respect of each holding of two shares of £10 each. The shares which have been sub-divided are termed £10 "A" ordinary shares, and the additional shares which were distributed are termed £10 "B" ordinary shares. According to the terms of the resolution authorizing the distribution of the "B" shares, these shares do not rank for dividend until after June 30, 1923. The first dividend upon these shares will be on the half-year's working to Dec. 31 next, payable in April, 1924. It will, therefore, be understood that the dividend which the Directors now recommend shall be paid on Oct. 5 applies to the £10 "A" ordinary shares only (into which the £20 shares are sub-divided). To avoid any misunderstanding as to future dividends, a letter was sent by the Secretary to every shareholder on March 28 last, pointing out that the increase in the capital of the Company would not necessarily mean an increase in dividends. Judging from some of the Press notices which I have seen it appears that some misapprehension exists on this matter. I therefore wish to remind you that after payment of the October dividend, the "A" and "B" shares will rank *pari passu*, and that from that date, if the profits available for dividend continue as in the past, the sum formerly paid by way of dividend on a £20 share will be divided between three shares of £10 each or (if you pass the resolution which is to be proposed at the extraordinary general meeting which will follow this meeting) £30 of stock. You will remember that in regard to the conversion, I pointed out that one of the important advantages of this would be that the dividend declared would more nearly approximate to the actual return received by the shareholders than at present. The dividend which it is expected you will approve to-day, together with the interim dividend already paid, is 11 p.ct. As you know, most of you have paid very large premiums for your shares, and this dividend, in many cases, will only mean a return of 5 p.ct. on the capital you have invested. When the conversion scheme is in full operation (if the profit divided among the shareholders next year is the same), the dividend declared will be 7⅓ p.ct. instead of 11 p.ct. The result of this will be that the nominal and actual return will more nearly approximate, and the public will not be misled into thinking that we are paying what might appear to be an unduly high dividend in connection with a statutory undertaking.

NEW MEMORANDUM.

With regard to the proposed new memorandum, enabling us to invest our money in water and electric light as well as in gas, the papers have been before Counsel for some time. The Long Vacation is now on; but as soon as the Courts re-open, the petition for the new memorandum will be presented.

AUDITORS' REMUNERATION.

A resolution will be proposed by one of the shareholders that Mr. Corrie and Mr. Cash be re-elected Auditors of the Company, and that their remuneration be doubled. I am very pleased to know this, as there is no doubt that the present salaries are quite inadequate having regard to the large amount of work entailed. It is more than fifty years since the Auditors' salaries were considered; it being as far back as March, 1871, when their salaries were increased from £50 to £100 a year each.

GROWTH OF THE COMPANY.

It may interest you to know that at that time the annual sales of gas at Hull amounted to 174 million c.ft., whereas to-day they are 1528 millions, and at Norwich the sales were 188 millions, compared with 741 millions to-day. In further illustration of the growth of the Company, the capital expended at the five stations in 1870 amounted to £256,000, whereas to-day the expenditure at the four stations is £1,455,000.

RESULTS EXCELLENT.

I am glad to be able to tell you that all our stations are in good order, and the plant is in all cases up to date. The results obtained are excellent, and reflect great credit on our engineers and their assistants. I hope, gentlemen, that the account I have given you of our year's working is clear to you, and that it will be regarded as satisfactory. If there are any questions any of you wish to ask, I shall be happy to answer them to the best of my ability.

Shareholders' Remarks.

Asked by a shareholder what was the price charged by the Hull Corporation for gas,

The Chairman said that the Company will now sell to the Corporation at 7d. per therm in bulk, or (say) 2s. 8d. per 1000 c.ft., and the latter usually charge their consumers about 2s. per 1000 c.ft. more than the price they pay to the Company.

Mr. Samuel Spencer, congratulating the Board on the successful result of the year's working, said it was really marvellous when they read the figures and compared them with those of the past. The years during which he had been associated with the Company as a shareholder were not many, but he wished he had been from the beginning. He was positive the Company would continue to be successful for many years. Great credit was due to the Company.

The resolution for the adoption of the report and accounts was seconded by Mr. Frederick Wilkin (a Director), and carried unanimously.

The Dividend.

The Chairman then proposed that the payment by the Directors of the dividend of 7 p.ct. per annum on the cumulative preference shares be confirmed.

Mr. F. Wilkin seconded this; and the resolution was carried unanimously.

The Chairman proposed that the payment by the Directors of the interim dividend of 5 p.ct. on the ordinary shares be confirmed, and that a final dividend on the £10 "A" ordinary shares of 6 p.ct. (less income-tax), making 11 p.ct. for the year, be declared.

Mr. F. Wilkin seconded the resolution, which was agreed to.

Re-Elections.

Mr. Frederick Wilkin and Mr. Harold G. Palmer were unanimously re-elected Directors of the Company.

Auditors' Remuneration Increased.

Mr. Samuel Spencer, in proposing that the Auditors (Mr. E. Knowles Corrie and Mr. William Cash, F.C.A.) be re-elected, and that their remuneration be increased from £100 to £200 each per annum (free of income-tax), said how pleased the shareholders were that Mr. Cash had offered himself for re-election. He had been amazed to hear that there had been no increase of the Auditors' fees for fifty years. This was probably a record in London for an indifferently prosperous Company; but for auditing the books of this Company, the fee must have been inadequate for many years. Considering the time which had elapsed since the last increase, he did not think the present increase was as much as it ought to be, but perhaps it would be added to later.

Mr. C. A. Morgan seconded the resolution, which was carried unanimously.

Mr. E. Knowles Corrie returned thanks, on behalf of Mr. Cash and himself, for their re-election as Auditors, and for the liberality shown.

Votes of Thanks.

Lieut.-Colonel W. F. T. Corrie, in expressing thanks to the Chairman and Directors for the way they had carried on the business of the Company, said that the shareholders felt tremendous confidence in them. He himself (as an ordinary layman) felt that the Chairman was a genius in putting the complicated financial business of the Company before the meeting so clearly. The shareholders owed a great deal to him and to the Directors.

Mr. W. J. Liberty seconded, and the vote of thanks was carried with enthusiasm.

The Chairman briefly thanked the meeting on behalf of himself and the Directors.

Mr. Liberty moved that the heartiest thanks of the meeting be given to the Secretary, officers, staff, and workmen.

The Chairman asked to be allowed to second this motion, because he knew a little more than the shareholders, perhaps, of the excellent service rendered by those named in the resolution. The Company were extraordinarily fortunate in this respect. The secretarial work was done in the most efficient possible way, and it made the work of himself and the Directors much simpler and smoother to know that they had a Secretary who had their entire confidence. The engineers at the various stations held high positions in their profession. The Company had a good reputation for the way in which they treated all their officers; and the result was that they had obtained the best men in the service. The shareholders could not possibly thank them sufficiently for the work they did, and he was satisfied that the Company could not be better served by any body of men. These remarks also applied to the workmen, who are working excellently.

The resolution was carried unanimously.

The Secretary (Mr. A. W. Brookes), acknowledging the vote of thanks, said he would convey it to all concerned. He also referred to the work involved in auditing the books of the Company, which was equal to undertaking an audit of four or five separate gas companies,

and expressed his pleasure that the services of the Auditors had been recognized in a substantial manner.

Extraordinary General Meeting.

An Extraordinary General Meeting was held immediately after the annual general meeting, for the purpose of sanctioning conversion of capital.

The CHAIRMAN moved as an Extraordinary Resolution that, in accordance with the provisions of the Company's Articles of Association, the 10,000 7 p.ct. cumulative preference shares of £10 each which have been issued and fully paid up be converted into 7 p.ct. cumulative preference stock, and the 85,500 ordinary shares of £10 each issued and fully paid up be converted into ordinary stock. He added that, when the resolution had been passed, the Directors proposed to fix the minimum amount of stock transferable at £1.

Mr. F. WILKIN seconded; and the resolution was carried unanimously.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

Half-Yearly Meeting.

The Half-Yearly Meeting of the Company was held on Thursday last at the Offices, D'Olier Street, Dublin—Mr. JOHN MURPHY (the Chairman) presiding.

The CHAIRMAN, in moving the adoption of the report and statement of accounts [see "JOURNAL," Sept. 26, p. 943] for the six months ended June 30, 1923, referred to the satisfactory nature of the figures submitted for consideration, and to the steadily maintained and increasing improvement in the affairs of the Company. The capital expenditure was heavier than usual. This indicated an expansion of business in the form of new and additional consumers. During the six months a large number of applications had been received for a supply of gas to various housing sites throughout the area of supply, which had necessitated the laying of services and the fixing of new meters, stoves, and fittings in considerable numbers. The actual amount expended totalled £9333, while the sales, depreciation, and credits amounted only to £4333; consequently the total expenditure on capital account was increased by £5000. Further economies had been effected since the corresponding period in the purchase and use of what may be described as raw materials—coal and oil. The saving in this connection had amounted to the substantial sum of £43,713. On the other hand, they had had to concede to customers for coke and breeze almost £10,000. However, after allowing for this, the balance was still on the right side, as the receipts for tar only showed a slight falling-off, while the income from sulphate had increased by 50 p.ct., or from £2114 to £3197. The only other item relating to the manufacture of gas which called for any comment was that of repair and maintenance of works, which showed an increase of £8918 over the figure for the half-year ended June 30, 1922. In view of the satisfactory results obtained from the vertical retort installation recently constructed, the Directors decided, rather than expend large sums of money in resetting the existing benches of horizontal retorts, to replace them by a corresponding installation of verticals. He was glad to be able to report that the work had been commenced, and was progressing satisfactorily. The expenditure on distribution compared very favourably with the corresponding period; the total being down to the extent of £2253. Salaries and wages were almost identical. A small saving had been effected under the heading of mains and meters; while stoves and fittings had cost slightly more. With regard to mains, it was found on examination that a number of the smaller sizes laid many years ago required renewing, and the result of carrying out this work appeared to have amply justified the expenditure by reason of the improved gas supply afforded to a large number of consumers. The cost of repairing and renewing was still very high. With regard to income, the net receipts for gas were down by £27,473, due almost entirely to the reduction in price, as the consumption had remained about the same. The expenditure for the half-year was down to the extent of £43,000, while income was less by £37,000; and thus they were enabled to carry into net revenue account a profit larger by almost £6000. The balance of net revenue available (£60,298) would permit of the maximum statutory dividend of £6 5s. p.ct. per annum being paid; but the Directors could not recommend a larger dividend than 5½ p.ct., in view of the fact that the reserve fund still required strengthening, and this could only be done out of divisible profits. They had, therefore, made an appropriation of £5819 to the reserve fund, and the balance of £11,802 10s. 3d. would remain to be carried forward to the next account. On the last occasion when he addressed them he referred to a reduction of 2d. per therm (or 9d. per 1000 c.ft.) in the price of gas from the March quarter, and pointed out that no effort would be spared to effect still further reductions. He was obliged to add, however, that before this could be done a reduction in wages was an essential. There could be no doubt that the present rates had reached a wholly uneconomic level. At the same time it was not considered that the present was a favourable occasion for raising the question.

DIVIDEND DECLARED.

On the motion of the CHAIRMAN, seconded by Mr. AUGUSTINE BIRD, a dividend of 5½ p.ct. per annum (less income-tax) on the consolidated ordinary stock of the Company was declared.

Increased Consumption at Smethwick.—Mr. S. W. Stephen (the Chairman of the Gas Committee) mentioned at a meeting of the Smethwick Town Council last week that complaints had been made regarding the low pressure of gas in the Bearwood district, particularly about midday on Sundays. He said that, as a result of the recent advertising campaign, and the opening of the gas showroom, the Committee had had very big demands upon them in that district specially; and the main originally laid down was not sufficient to cope with them. Alterations were proceeding, and the opportunity would be taken to put in larger mains, with a view to removing the cause of complaint.

GAS PRICES IN BIRMINGHAM.

A Reduction of Sixpence.

The gas consumers of Birmingham—domestic and industrial—are rejoicing in the prospect of a substantial reduction of 6d. per 1000 c.ft. as from the September reading of their meters. The Gas Committee have made the recommendation; and the matter now awaits ratification by the Council.

The new charges will be in accordance with the following scale:

For Lighting, Cooking, and Domestic Purposes in One Premises.

Per Quarter.	Per 1000 C.Ft. From		To
Up to and including 100,000 c.ft.	3/7	..	3/1
Quantity in excess of:			
100,000 c.ft. up to 500,000 c.ft.	3/6	..	3/-
500,000 c.ft. up to 1,000,000 c.ft.	3/5	..	2/11
1,000,000 c.ft. up to 2,000,000 c.ft.	3/3	..	2/9
2,000,000 c.ft. up to 3,000,000 c.ft.	3/1	..	2/7
3,000,000 c.ft. up to 4,000,000 c.ft.	2/10	..	2/4
4,000,000 c.ft.	2/7	..	2/1

For Manufacturing and Motive Power in One Premises.

Up to and including 1,000,000 c.ft.	3/1	..	2/7
Quantity in excess of:			
1,000,000 c.ft. up to 2,000,000 c.ft.	2/10	..	2/4
2,000,000 c.ft. up to 3,000,000 c.ft.	2/7	..	2/1
3,000,000 c.ft. up to 4,000,000 c.ft.	2/6	..	2/-
4,000,000 c.ft.	2/4	..	1/10

These prices are subject to 5 p.ct. discount for prompt payment.

The quantity of gas supplied through prepayment meters will be increased as follows:

	Installations in Use less than Ten Years. C.Ft. per 1d. From		To	Installations in Use Ten Years and Upwards. C.Ft. per 1d. From		To
With meter only	23	..	27	23	..	27
With meter and Corporation fittings	22	..	25	23	..	27
With meter and Corporation cooker	21	..	24	22	..	25
With meter, Corporation cooker, and fittings	20	..	23	22	..	25

The last reduction of 3d. (from 3s. 10d. to 3s. 7d.) was made operative after the March reading of the meters this year.

THE STANDARD PRICE AT BRIGHTON.

Agreed Reduction.

There has been an interview between a Sub-Committee of the Legal and Parliamentary Committee—Alderman Stevens and Councillor Black, with the Town Clerk and the Borough Accountant—and the Chairman of the Brighton and Hove General Gas Company (Mr. A. M. Paddon) and Mr. Joseph Cash, together with the General Manager (Mr. C. H. Rutter) and the Secretary. It was pointed out that, having regard to the altered circumstances as revealed by their last balance-sheet, the present standard price of 15·2d. per therm was, in the opinion of the Brighton Corporation, unduly high. After a friendly discussion, Mr. Paddon made the following suggestions: (1) That the Company would agree to a reduction in the standard price under the Gas Regulation Act, 1920, from 15·2d. to 14d. per therm to operate from the amending Order of the Board of Trade. (2) That, subject to no abnormal conditions arising, the Company confidently hope to reduce the price of gas to the extent of 1d. per therm on or before April 1 next. The representatives of the Corporation considered the offer reasonable; and the Sub-Committee recommended its acceptance.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

Interim Dividend.

Signed by the Chairman (Sir Charles J. Jessel, Bart.), the Imperial Continental Gas Association make the following announcement: The Board intend shortly to declare an interim dividend at the rate of 5 p.ct.—actual—on the £1,976,000 capital stock, payable, less income-tax at 4s. 7½d. in the £—*i.e.*, the average rate for the year 1923—on Nov. 15, 1923.

As the Inland Revenue Authorities have advised the Association that the proportion of the German compromise which has been received to date must be apportioned over capital and revenue in the accounts for 1923, an apportionment has been made which gives a net revenue sum of £86,157 available for appropriation, after making provision for taxation. The Board propose that the interim dividend, amounting to £75,952 10s. net, shall be appropriated from this German compromise revenue. In view of the violent fluctuations in Foreign Exchanges, and the consequent difficulty in framing reliable estimates of the final results of the working year 1923, the Board have decided not to pay a dividend in respect of the normal workings of the Association until the final results of the whole year have been definitely ascertained.

Further Reductions in Price at Bolton.—A further reduction in the price of gas was decided upon by the Bolton Gas Committee on the 28th ult. The sliding scales adopted last March are retained, but the gradations are altered; and the new scale, starting at a maximum of 4s. in the borough and 4s. 3d. outside (as before) for the smallest consumers, falls to 3s. and 3s. 3d. for the largest, as against 3s. 3d. and 3s. 6d. on the old scale. The new scale becomes operative as from September.

COLONIAL GAS ASSOCIATION, LTD.

Control and Management of the Company to be Transferred to Melbourne.

An Extraordinary General Meeting of the Company was held on Tuesday of last week, at the Cannon Street Hotel, London, E.C., to consider a series of resolutions having for their object the transfer of the control and management of the Company from London to Melbourne, and vesting it in a Board of Directors to be resident in Australia. Mr. Samuel Spencer (the Chairman) presided.

In the circular calling the meeting, it was pointed out that, if this step were taken, the effect would be to make the profits of the Company subject to Australian income-tax only, save so far as they were remitted to this country. Moreover, if the change were made the divisible profits might reasonably be expected to increase. At the present time, as the management of the Company was controlled from London, both British and Australian income-tax was payable upon the whole of the Company's profits—a matter which had engaged the attention of the Directors for some time, though no satisfactory measure of complete relief had been procured. It had been found by a number of companies similarly situated that the only effective method of avoiding the heavy burden of double taxation was to remove the entire control and management from London to Australia. A substantial number of shares in the Company were now held by residents in Australia; and the expansion of the Company's activities in the Commonwealth would probably lead to further investment by Australians in the shares of the Company. Leading Australian shareholders had indicated their support of the resolutions. The Directors, having exhaustively considered the matter, were of opinion that all shareholders, both Australian and British, would be well advised to vote in favour of the resolutions. Proposed alterations in the Company's articles were mainly designed to effectuate this purpose, though at the same time the opportunity had been taken to bring some of the Articles up to date.

In all, there were twelve resolutions submitted to the meeting. Resolutions Nos. 1 to 5 were taken together. These provided that on and from Jan. 1, 1924, the whole of the business of the Company, except such formal parts as were, by Statutes for the time being applicable to the Company, required to be transacted in England, or at the registered office of the Company for the time being, should be transacted in Melbourne, or elsewhere in Australia as the Company might from time to time in general meeting determine. That from the date named all Directors of the Company should be ordinarily resident in Melbourne or elsewhere in Australia; and that for this purpose the Board of the Company should from then consist of Mr. P. C. Holmes Hunt, Mr. J. Simpson Weir, and Sir John W. Taverner, K.C.M.G., and such other persons not exceeding two as might be approved by the Company in general meeting. For the purpose of the transaction of such formal or other business as was required to be transacted in England or at the registered office of the Company, the Board might appoint one or more Local Directors, so as to form, if thought fit, a Local Board to act in England under the general control of the Australian Board; and the Board should appoint a Secretary and other officers to represent the Company. The Board should procure proper audits, including, if necessary, the auditing of the accounts by Auditors appointed in England. No part of the profits of the Company should be transmitted to the United Kingdom, except in payment of dividends to members ordinarily resident there.

The Secretary (Mr. A. J. Kingdon) having read the resolutions,

The Chairman formally moved their adoption.

Mr. P. C. Holmes Hunt (Chairman and Managing Director in Australia) said that, in seconding the motion, and in amplification of the proposals now submitted, he would like to give the shareholders some additional explanations. In the first place, however, he desired to express his keen satisfaction at being present at a meeting of shareholders in London—his first appearance since he had had the honour to join the Melbourne Board some ten years ago. He wished to refer briefly to the progress made by the Association as revealed in the accounts during the past few years. Since 1914 the output of gas had increased so substantially that during the year just closed they sold approximately three times as much gas as in 1914. Recent developments in Australia pointed to this rate of increase being fully maintained. Australia was still a very young and vigorous country; and though, naturally, its resources were chiefly concerned with the fertility of its soil and the huge possibility of increasing agricultural products, yet, as more people were settled on the land, it followed that more demands were made on the cities for manufactured articles for the use of those workers; and consequently, as manufacturing increased in towns, employment increased, and the demand for gas must continue to be considerable. The Association's experience was that, in the suburbs such as they supplied on the outer fringe of Melbourne, the population was increasing and spreading at a rapid rate—so much so that they were forced to undertake considerable extensions of plant and mains in order to keep pace with the demand. Moreover, at several of their smaller stations a vigorous growth was being experienced. They supplied three very important suburbs of Melbourne—Footscray, Box Hill, and Oakleigh—and at the works supplying these areas they were actually committed to an expenditure of upwards of £50,000 for a new gasholder, high-pressure mains, and other plant, all absolutely necessary if they were to give satisfaction to their present consumers and to make more gas available for new ones. Apart from these commitments, they had under consideration other equally pressing items amounting to some £35,000; and the whole of the expenditure would be of a distinctly remunerative character. Shareholders were aware that in recent years it had not been easy to raise capital as required; and the difficulty with which the Association were faced, if they were to keep pace with the legitimate growth of their business, was properly to finance these highly necessary extensions. In June last, they issued a prospectus in London, and invited subscriptions for new capital to the extent of £66,000. He was sorry to inform them that the total subscriptions only amounted to under £20,000. This amount did not include any subscriptions from Australia, for the reason that it was very difficult to raise money in Australia at the present rate of dividend, from which was deducted the British income-tax. Last year the net return to the ordinary shareholder amounted to £7 11s. p.ct. The field for obtaining additional capital in Australia at the present time was therefore closed, for two cogent reasons: First, the deduction of English income-tax from Australian dividends, which were again taxed by the Australian taxation authorities; and, secondly, the reduced market value of shares in Australia caused by the reductions mentioned. If, however, the British income-tax liability on Australian shares was done away with—and this could only be done by transferring the control to Melbourne—the Directors had every reason to believe that they would be able to obtain capital in Australia in addition to any capital available in England, for everyone would agree that a dividend of 9 p.ct. free of British tax should attract capital in Australia. It was obviously to the advantage of the Association that they should be put in the best position for raising capital both in Australia and in England; and as this could be done by removing the head office to Melbourne, and without adversely affecting the interests of the English shareholders at all, the Directors had concluded that it was the right thing to do. It should be thoroughly realized by shareholders that no substantial change in the management was intended, as the business of the Company had, of course, always been carried on in Australia. The removal of the head office to Melbourne would, of course, free the Company from British income-tax on the dividends paid in Australia. The English shareholder would still have to pay his income-tax; but he would be no worse off than he was to-day. The Australian shareholder would be rather better off; and the Company would be in the improved position of being able to command capital in Australia. For these reasons the Board, after most earnest consideration, had decided upon recommending the change. In the alterations, however, the English shareholders would be fully protected. Their voting powers would still be preserved; and the freeing of profits from the load of English taxation must eventually re-act favourably upon the Company's undertaking. The new arrangement would give them a much better chance of increasing the scope of the whole concern. As long as the operations were formally controlled from London, it was difficult to acquire new undertakings. Once this alteration was made, the dividends would be paid earlier than was the case at present; and in this connection he was pleased to inform the shareholders that the accounts from Melbourne had now been received. The Secretary was busy on them; and the indications were that there need be no fear as to the Association's ability to repeat what was done last year in the way of dividend. The Board had received a very large number of proxies, on behalf of English as well as Australian shareholders, in favour of the scheme; and nothing at all against the proposal had reached them.

Mr. W. W. Topley: What are the relative proportions of capital at present held in England and in Australia?

The Chairman: 30 p.ct. abroad, and 70 p.ct. here. Replying to a further question, he stated that tax would be deducted from dividends paid in England on the same basis as heretofore.

Mr. Holmes Hunt, answering a query, said the Australian Board would return to the payment of interim dividends as soon as possible.

Mr. Matthew Curry asked whether the present English shareholders would have put their money into an Australian concern managed in Australia. He ventured to say they would not. The English shareholders had invested in the undertaking just because it was managed in England. Under the new arrangement, the profits might be depleted for capital purposes; and they would have no control at all over the matter.

Mr. Henry Woodall: How can the shareholders in Australia profit without our profiting to the same extent?

Mr. D. T. Livesey agreed that it was a rather drastic proposal to bring forward without any preliminary notice. They had all very great confidence in the Chairman and other members of the Board; and what he had to say therefore was entirely on the question of principle. From this point of view he could see no justification for so radical a suggestion as that the proprietors of 70 p.ct. of the capital should give up control to the other 30 p.ct. The whole thing was asking too much of the English shareholders. Better reasons than had been advanced should be given before a decision of this kind was asked for.

Mr. Holmes Hunt said the real object of the scheme was that they might be able to get money at both ends—in England and Australia—to keep pace with the increase in business that was being experienced. The position of the English shareholders would not be prejudiced. The Board would issue from the London office in due time before meetings took place in Melbourne a circular setting forth the main points of the accounts and matters to be dealt with at the meeting; and English shareholders would have an opportunity of sending in proxies to the London office which would be cabled to Melbourne and used at the meeting.

Mr. W. J. Liberty suggested that if the Association had had a Stock Exchange quotation, it would have been possible to obtain capital more freely. In the event of the scheme going through, would the Board be able to get a quotation on the Australian Stock Exchange, which would be quoted back here, and so fix a value for the shares?

Mr. Holmes Hunt replied that this point had not been lost sight of. They would obtain a Stock Exchange quotation in Melbourne within a few months of the change-over; and for the assistance of shareholders in England, he would undertake to say that the London office would be advised of market transactions taking place in Melbourne. On application to the Secretary, English shareholders would thus be able to ascertain the value on the Melbourne Stock Exchange.

The Chairman said he had been connected with the Association since its inception; and he felt sure the scheme was a good one. The Board had proxies enough to carry the matter through.

Resolutions Nos. 1 to 5 were then put to the meeting, and carried; eighteen voting for, and four against.

The Solicitor (Mr. Sydney Norse) then briefly explained the effect of the six resolutions relating to the Articles of Association; and they were carried, on the proposition of the Chairman, seconded by Mr. Holmes Hunt.

The Chairman next proposed Resolution No. 12: "The Directors are hereby authorized to pay to any present Director of the Company

on retiring from that office in accordance with the foregoing resolutions, who is not appointed a member of any Local Board or Committee of the Company in London, as compensation or allowance for loss of office, the sum of £600 for each."

Mr. HOLMES HUNT seconded, and pointed out that the intention was that three of the existing Directors would be continued on Jan. 1 next as members of the local Board in London. Only one Director would retire; and the shareholders were asked to agree that compensation of £600 should be paid him.

This was agreed to; and a vote of thanks to the Chairman for presiding, on the proposition of Mr. LIBERTY, seconded by Mr. SAWARD, brought the proceedings to a close.

PUBLIC WORKS, ROADS, AND TRANSPORT CONGRESS AND EXHIBITION.

We have received a list of the firms who have so far been allotted space at the above exhibition.

Allchin, Wm., Ltd.
Alloy Welding Processes, Ltd.
Ames Crosta Sanitary Eng. Co., Ltd.
Archer, W. & F.
Armstrong, Sir W. G., Whitworth, & Co., Ltd.
Atha, J. W., & Co.
Atkinson & Co.
Aveling and Porter, Ltd.
Avery, W. & T., Ltd.
Barford and Perkins, Ltd.
Barnes, F. G.
Beck & Co., Ltd.
Berendsen, Sophus (London), Ltd.
Berry, Wiggins, & Co., Ltd.
Blackstone & Co., Ltd.
Bristowes Machinery, Ltd.
Bristowes Tarvia, Ltd.
British Opalograph Co., Ltd.
British Petroleum Co., Ltd.
British Reinforced Concrete Eng. Co., Ltd.
Brookes, Ltd.
Broom & Wade, Ltd.
Brown and Tawse, Ltd.
Brunner, Mond, & Co., Ltd.
Builders' and Contractors' Plant, Ltd.
Carriers Publishing Co., Ltd.
Chemical Engineering Products, Ltd.
Clare, R. S., & Co., Ltd.
Clayton Wagons, Ltd.
Clee Hill Granite Co., Ltd.
Coleman, Thomas, and Sons, Ltd.
Constable, Hart, & Co., Ltd.
Crow, Catchpole, & Co., Ltd.
Dominion Machinery Co., Ltd.
Dorman, W. H., & Co., Ltd.
Drummond Bros., Ltd.
Durable Roads, Ltd.
Eddison Steam Rolling Co., Ltd.
Electricars, Ltd.
Enderby and Stoney Stanton Granite Co., Ltd.
Engineering and Light Railway Co.
Expanded Metal Co., Ltd.
Ferodo, Ltd.
Field and Mackay, Ltd.
Foster, Wm., & Co., Ltd.
Fowler, J., & Co. (Leeds), Ltd.
Francois Cementation Co., Ltd.
Garrett, R., & Sons, Ltd.
Gaston, Ltd.
Glossop, W. & J.
Goodwin Barsby & Co., Ltd.
Green, T., & Son, Ltd.
Grunspan, A. S.
Hadfield, John, & Sons, Ltd.
Hatch, George, Ltd.
Haulage Improvements & Constructions, Ltd.
Haunchwood Brick & Tile Co., Ltd.
Hayward Co.
Heeandi, Ltd.
Helical Bar & Engineering Co.
Highways Construction, Ltd.
Hill, Richard, & Co., Ltd.
Horsman, W. E., Son, & Co.
Horstmann Gear Co., Ltd.
Indented Bar & Concrete Eng. Co., Ltd.
Ingersoll Rand Co., Ltd.
Jeavons, E. E., & Co., Ltd.
Johnson, B., & Son
Johnson's Reinforced Concrete Eng. Co., Ltd.
Johnston Bros.
Jones, W.
Kent, George, Ltd.
Klinger Patents
Lacre Motor Car Co., Ltd.
Lafarge Aluminous Cement Co., Ltd.
Laffly (England) Co., Ltd.
Lamb, W. T., & Sons
Limmer & Trinidad Lake Asphalt Co., Ltd.
Low Laithes Colliery Co., Ltd.
Manchester Water Meter Co.
Mann's Patent Steam Cart & Wagon Co.
Marsden, H. R., & Co.
Marshall, Sons, & Co., Ltd.
Mathews, Ernest, & Co.
Millars' Timber & Trading Co., Ltd.
Mono Pipe Works
Mowlem, John, & Co., Ltd.
National Benzole Co., Ltd.
Neuchatel Asphalte Co., Ltd.
Newsome, Arthur, Ltd.
Norman and Hill, Ltd.
Ord and Maddison, Ltd.
Oxford Steam Plough Co., Ltd.
Park, Wm., & Co.
Parker, F.
Parker, Turnbull, & Co.
Parkinson and W. & B. Cowan, Ltd.
Patent Lightning Crusher Co., Ltd.
Paterson Engineering Co., Ltd.
Penlee and St. Ives Stone Quarries, Ltd.
Penmaenmawr and Welsh Granite Co., Ltd.
Peters, C. A., Ltd.
Phœnix Engineering Co., Ltd.
Pike, George
Premier Bitumen Asphalte Co., Ltd.
Ransome Machinery Co. (1920), Ltd.
Rawlplug Co., Ltd.
Reavell & Co., Ltd.
Robey & Co., Ltd.
Rocmac, Ltd.
Ross, Arthur, Hotchkiss, & Co., Ltd.
Royal Label Factory
Ruston and Hornsby, Ltd.
"Sentinel" Waggon Works (1920), Ltd.
Sharp, Jones, & Co., Ltd.
Shell-Mex, Ltd.
Shepherd, Philip, & Co., Ltd.
Shepherd, Wm., & Sons, Ltd.
Ship Canal Portland Cement Manufacturers, Ltd.
Slingsby, H. C.
Smith, H. V., & Co., Ltd.
South of England Agricultural Machinery Co., Ltd.
Staveley Coal and Iron Co., Ltd.
Steingold, I. & M.
Stolzenberg Patent File Co., Ltd.
Stoneware, Ltd.
Stothert & Pitt, Ltd.
Sussex Brick & Estates Co.
Tangyes, Ltd.
Tarmac, Ltd.
Tarslag, Ltd.
Texas Oil Co., Ltd.
Thomas & Bishop, Ltd.
Tidnams, Ltd.
Tuke & Bell, Ltd.
Underriver Ladder Works
Wake, J. F.
Walker-Weston Co., Ltd.
Waller, G., & Son, Ltd.
Wallis & Steevens, Ltd.
Walters, F., & Co.
Weeks, W., & Son, Ltd.
Wells, A. C., & Co.
Wettern Bros.
Wilson & Perrett, Ltd.
Winget, Ltd.
Yates, J., & Co.
Yorkshire Patent Steam Wagon Company.
Yorkshire Road Tarbinders, Ltd.

South Australian Gas Company.—The profit of the Company (who supply Adelaide with gas), for the year ended June 30, amounted to £72,044; and with the sum brought into account, there was available £75,302. After payment of the usual dividends and transferring £5000 to reserve, there remained a balance of £10,508 to be carried forward

THE GAS-MANTLE IN THE MAKING.

A Visit to the Welsbach Factory.

There are many inventions in existence in regard to the manufacture of which the general public are ignorant; and the gas-mantle doubtless is one of them. Realizing this, and with a view to fostering the general interest that is being taken in the uses of gas—created in no small measure by the National Gas Exhibition at Birmingham and the activities of the "B.C.G.A."—the Welsbach Light Company regarded the time as opportune for inviting a number of Press representatives to visit their factory at Wandsworth for the purpose of witnessing the various up-to-date processes in the manufacture of gas-mantles. The visit was fixed for Friday last; and a good number of representatives of London and Provincial papers availed themselves of the Company's invitation.

Assembling at the works, the visitors were divided into convenient groups, and conducted round the factory by Mr. B. Bark (the Works Manager) and members of his staff.

The knitting room was first visited; and here were seen numerous machines knitting the yarn which forms the base of the mantle into long tubular fabrics or "stockings" of various sizes, tensions, and types of stitch. The latter, it was explained, have an important bearing on the finished mantle. Some yarn is woven instead of knitted, giving a fabric which produces a mantle of great strength and durability. Cotton was the fabric employed in the early days; and an improved quality of this textile is still used for certain mantles. The material in general use at the present time, however, is ramie, which, by virtue of its physical properties, gives a mantle of greater strength and durability than that obtained from cotton. Yet another material used in manufacture is artificial silk, which produces a strong, though very flexible, mantle. For this reason, silk mantles are often sent out in an unburnt or soft condition, and are burnt-off and shaped on the burners by consumers.

After knitting, the rolls of stockings have to undergo a washing process, and are immersed in nitric or hydrochloric acid, to reduce the ash content. The importance of this washing will be appreciated when it is mentioned that should the ash content exceed 0·02 p.ct., the finished mantle would be injuriously affected. The fabric is partially dried in a centrifugal machine, and then soaked in distilled water; the centrifuging and washing being continued until the fabric is free from acid.

The drying of the fabric is the next process. This is done by slowly passing it over rollers and through specially constructed drying chambers; the width of the stocking being carefully gauged by the attendant while passing over the rollers.

Having passed through the drying stage, the fabric is ready for impregnating with thorium nitrate or "lighting fluid." For this process the Welsbach Company have installed very ingenious machines, which we understand are the only ones of the kind in Europe. The fabric, still in its stocking condition, is placed in a vessel containing the impregnating fluid, and when thoroughly impregnated passes through rollers, which can be so minutely adjusted that not only is the surplus fluid removed, but the correct weight required for any mantle remains in the fabric. In the course of its travel through this machine the stocking passes through a drying chamber, and is then ready for cutting up into lengths for the various sizes of mantles. This process is carried out both by hand and machine.

The lengths of fabric are then passed on to the sewing room, where those intended for upright mantles have one end doubled-in and sewn. This forms the top of the mantle. In some cases a piece of tulle is inserted in the top to give additional support.

The next process is that of fixing. The object of this operation is further to strengthen that part of the mantle which will be subjected to the greatest strain. In the case of upright mantles this is the head, and in inverted mantles the end which is attached to the clay ring. The mantle is passed between revolving felt pads saturated with a solution of special nitrates. On subsequently burning off and seasoning the mantle, the portion "fixed" shrinks more than the body, and so becomes more compact and stronger. Before taking their final shape the mantles are branded. This is done by stamping with a solution containing a mixture of rare earths, which on heating leaves a dark brown oxide.

While the whole of the foregoing processes are chiefly of a mechanical nature, a stage in the manufacture has now been reached in which the skill and dexterity of the individual workers are called for. These are the processes of sewing and modelling. Upright mantles have the heads drawn together with asbestos thread, which is then tied to form a loop for suspending from the rod. Inverted mantles have one end drawn together, forming the "spider," and the other attached with asbestos thread to the clay ring. In the process of modelling, the mantles are placed on models and carefully stretched and shaped by hand, and are then ready for burning off, shaping, and seasoning.

The "burning off"—a process by which the organic matter is removed and the nitrates converted into oxides—is carried out in chambers in which the upright mantles, suspended by their asbestos loops, are arranged in long rows on a rod, and the fabric is ignited from the top, so that it burns downwards. When carbonization is complete, the mantle, reduced by shrinkage to about half its original size, is shaped by passing a high-pressure gas flame through the interior. The rows of mantles are then placed in another cabinet, where the seasoning is carried out by high-pressure gas. Inverted mantles are similarly treated, except that the shaping and seasoning are performed in one operation in an enclosed furnace. Though the foregoing processes are largely automatic, considerable skill and knowledge are required by the operator, in order correctly to adjust the size and shape of the flame.

The mantle has now reached the stage of completion; but being merely a skeleton of ash, and therefore very friable, it has to be treated with a protecting film of collodion, to render it capable of being handled. The protective coating is applied by dipping the batches of mantles in a bath containing the solution, and drying them in a heated chamber.

While every care is exercised in carrying out the various stages of manufacture, every mantle is thoroughly examined and tested for size and shape by experts before it is packed, and all but the perfect are rejected. Samples of the mantles are also submitted to a test on a Moon "shocking" machine—a most ingenious device which automatically registers the number of shocks given.

In the packing room the visitors had an opportunity of seeing the mantles finally boxed up; the boxes and cartons used for the purpose all being made on the Company's premises.

Gas lighting is employed throughout the factory except in the collodionizing room, which, owing to the explosive nature of the material used, is lighted by sealed electric lamps. The current for this, however, Mr. Bark was careful to explain to the visitors, is generated by gas-engines.

In the course of their tour through the factory favourable comment was made by the visitors on the extreme cleanliness and cheerful surroundings of the workrooms, all of which are lofty and well ventilated.

The Company's Guests at Lunch.

At the conclusion of the visit the party were entertained to luncheon, at which the Chairman of the Company (Mr. J. R. Yates) presided, being supported by the General Manager (Mr. H. Talbot).

Mr. Yates, on behalf of the Directors of the Company, expressed the pleasure it gave him to welcome the members of the Press to their factory, remarking that this was the first Press visit to their works in the history of the Company. Dealing with the early history of the gas-mantle, he said the first mantle to arrive in this country was brought from Vienna, suspended in a bird cage. The initial methods of manufacture were very crude compared with those in use at the present time; many of the operations now performed by machinery being then done by hand. The mantle made in the early days was supported from the top by a platinum wire attached to an iron side-supporting wire, which, in turn, was fixed to the burner. In this form the mantle was sold to the consumer; and in the Company's early experience many such mantles were sent for by London Gas Companies by messengers who travelled in cabs—even with a single mantle—in order to ensure the safe arrival of their burden at its destination. The use of the modern collodion to ensure safe packing and transportation, dated from about 1890. There was a tendency in some quarters to decry gas lighting in comparison with that by electricity; but both on the ground of appearance and also from comparative spectro-metric examination, gas showed superiority to electric light and was less harmful to the sight than the now prevalent high-power gas-filled lamps. Results and experiments indicated that the light of the incandescent mantle more nearly approached sunlight than did any other artificial light. The production of Welsbach mantles, which since the manufacture started have always been made at Wandsworth and are "all and always British," gave direct employment to many hundreds of workers; and the mantle industry generally, to many thousands. The British mantle industry, in common with other branches of trade, suffered from foreign competition and dumping, as the weekly statistics published by the Board of Trade abundantly proved. Up to Sept. 15 no fewer than 108,788 gross of mantles had been imported into this country since the beginning of the year, notwithstanding the provisions of the Safeguarding of Industries Act. The Welsbach Company, however, had strong hope for a favourable future for the gas industry in general, and asked fair play for that brilliant handmaid of the industry—the British incandescent mantle.

TRADE NOTES.

Geyser Fixing.

A useful booklet entitled "Geyser Fixing" has just been published by the Davis Gas-Stove Company, Ltd., of No. 60, Oxford Street, London, W. This summarizes the experience of the firm, based upon the constant calls which they receive to inspect installations of geysers of every make. It is designed for distribution among geyser fitters, who will doubtless find the practical information which it contains of great assistance to them. Faulty fixing will damage the reputation of the best of geysers, so that the Davis Company have the closest interest in the subject with which the booklet deals.

Ackworth Gas Company.—The Directors of the Ackworth, Featherstone, Furston, and Sharlstone Gas Company, in their report, stated that the gross profit on revenue account for the year was £2369. They recommended a dividend of 6 p.ct. on the "A" stock and £4 4s. p.ct. on the "B" stock; and this was confirmed by the shareholders at the meeting.

Leamington Priors Gas Company.—Alderman T. W. Thursfield, M.D., J.P. (the Chairman), presided at the 117th general meeting of the Company last week, and expressed the hope that the report and accounts would be considered satisfactory both by the consumers and the shareholders. They were proposing to pay the usual statutory dividends. A reduction in revenue from gas was due partly to a lowering of the price twelve months ago, and partly to a slight falling-off in the output. The prices at which the Company had made contracts for coal supplies until next Midsummer were slightly higher than last year's contract prices; but in spite of this, after very careful consideration, the Directors had decided to reduce the price of gas from 10d. to 9d. per therm after the end of the quarter. This was a 10 p.ct. reduction; and, going back to the old reckoning, it represented nearly 5d. per 1000 c.ft. A corresponding reduction would be made to the prepayment meter consumers, by giving them a rebate so that the net amount collected would represent 4s. 3d. per 1000 c.ft. instead of 4s. 8d. as it did now. The new price, corresponding to just over 3s. 7d. per 1000 c.ft., would be only 44 p.ct. above the pre-war price of 2s. 6d., comparing very favourably with the latest figures which he had seen from the Ministry of Labour giving the general increase in the cost of living as about 70 p.ct. above July, 1914.

NELSON (LANCS.) GAS ORDER.

Last Wednesday, Mr. H. C. Honey (Director of Gas Administration at the Board of Trade) attended at the Town Hall, Nelson, to consider an application by the Borough of Nelson for a Special Order under section 10 of the Gas Regulation Act, by which they sought authority for the acquisition and use for gas-works purposes of 6½ acres at Brierfield, the provision of an additional gasholder thereon, &c.

The Town Clerk (Mr. J. H. Baldwick) appeared for the Corporation, representing whom there were also present: Aldermen Fell and Townsley, Councillors Smith and Smithson, and Messrs. J. Mitchell (Gas Engineer), C. H. Brear (Borough Treasurer), W. Shackleton (Borough Surveyor). For the Brierfield Urban District Council there attended Councillor Riddiough, Mr. B. Halstead (Surveyor), and Mr. A. Armistead (Accountant). Originally an objection had been lodged by the Brierfield Council; but prior to the hearing this had been withdrawn. The only objectors remaining were Mrs. R. W. German (for whom Mr. German appeared), Mr. W. Thompson, and Messrs. T. Howarth and H. Walker (represented by Mr. C. W. Shutt). All of them are owners of property in Colne Road, Brierfield, in the neighbourhood to which the application had reference.

It may be mentioned that the gross capital outlay for the whole undertaking, at March 31, 1923, stood at £310,923, and the net capital at £88,627, which latter sum represents a net outlay of £170 per million c.ft. of gas made, as against £291 per million ten years ago. During the present financial year, a further expenditure of £12,000 for new purifiers and telpher has been sanctioned. The capital expended and authorized on the works alone at Brierfield is approximately £181,000; but figures are not available to show separately the revenue obtained from that outlay. It can be said, however, that during the past ten years the net profits of the department have varied between 2·4 p.ct. and 20·1 p.ct. of the net capital outlay. The rating assessment of the Brierfield Works and mains is £3406.

The Town Clerk, in opening the application, said the Corporation of Nelson owned and operated gas-works at Leeds Road, Nelson, and at Hollin Bank, Brierfield. The two installations of carbonizing plant were of the same type and equal capacity, and were worked in combination. The district supplied included the Borough of Nelson, the Urban Districts of Brierfield and Barrowford, and the Townships of Blacko and Wheatley Carr Booth. The total population of the area was 55,267, of which the borough contained 40,000. The application was for an Order authorizing the acquisition and use for gas-works purposes of 6½ acres of land at Brierfield, the provision of an additional gasholder thereon, and other matters. The present powers of the Company were obtained by a Local Act in 1866; the population of Nelson at that date being 3500. No additional powers had been obtained since the date of that Act, except in connection with matters of finance. With respect to land, the then Local Board were authorized to acquire the Nelson Works from the Nelson Gas Company, and also, by agreement, any other works then existing within the gas limits, which might either be maintained and extended or discontinued. The site of the Nelson Works contained 2·32 acres. In a schedule was described a plot of land at Hodge House, Nelson, of about 2½ acres in extent, which might be acquired compulsorily; and, in addition, further land not exceeding 10 acres might be acquired either for water-works or gas-works purposes, but was not to be used for the manufacture of gas, nor for storage within 200 yards of pre-existing dwelling-houses. The land in question was not purchased; and the powers lapsed at the expiration of three years from the passing of the Act. To the extent of the scheduled land, the Corporation were in a less favourable position with respect to the use of land than fifty years ago, when the population of the borough was less than one-tenth of the present.

In 1888, another Local Act (the Nelson Local Board Act) confirmed the purchase from Messrs. Tunstill of the works at Brierfield, which were in existence in 1866, and were authorized to be acquired by the 1866 Act. The site was treated as additional land within the provisions of the same Act, but free from the restrictions as to use which would have applied if no works had previously existed there. The Bill for the Act of 1888 was opposed on behalf of the inhabitants of Brierfield; and clauses were inserted for their protection which placed them as consumers in an extremely favourable position. One other purchase of private gas plant—viz., that of Messrs. William Ecroyd and Sons, Ltd., at Lomeshaye Mill, Nelson, in the year 1911, had been made by the Corporation under the provisions of the 1866 Act; but the site was not included, and the use of those works was discontinued. The total area of land acquired and held by the Corporation for gas-works purposes within the area of supply was 8·28 acres, of which 7·32 acres were available under existing powers for the manufacture and storage of gas. So far as the process of carbonization alone was concerned, the present sites were adequate, and, with the vertical type of retorts, would suffice for a production much in excess of the present demand. But for other purposes there was no surplus land available, and in particular it had been found desirable to remove and deposit elsewhere than in the yard of the Brierfield Works the clinker and similar refuse from those works. The 6½ acres of land referred to in the Order were not originally intended to be utilized for manufacture or storage of gas, as was stated in his letter to the Board of Trade dated Dec. 12, 1922. The reply to that letter pointed out that other powers might be included in an Order under section 10 of the Gas Regulation Act, 1920; and the Gas Committee thereupon gave their careful consideration to the matter. In view of the probable future development of the undertaking, instructions were given for the preparation of the draft Order as deposited.

With respect to the suitability of the 6¾ acres of land recently acquired, the following points might be mentioned: The site was within the area of supply. It was at the lowest point in that area. It adjoined existing works. It was in an industrial, and not a residential district. There were very few dwelling-houses within 200 yards of the nearest boundary; and all of these were nearer to the present works than to the land referred to in the Order. The site would have the advantage of the proximity of the canal and the railway—the latter being, in fact, the governing factor in the choice of site. The necessity

for further storage capacity was not pressing; but, on the other hand, it was by no means remote, as the small holders in Nelson were old, and could not be kept in serviceable condition much longer. The only other holder was the one at the Brierfield Works, which had a capacity of 1,800,000 c.ft.; the maximum required for a day's supply being now 2,406,000 c.ft. Obviously the one holder mentioned was not sufficient—especially in view of the increasing demand—to satisfy a prudent Committee charged with the duty of supply. It was not, however, intended to provide an additional holder immediately; and it was hoped that such expenditure, when it could no longer be deferred, might be reduced by a return to more favourable prices than now prevailed.

He was happy to state that, of the objections received, those of the London, Midland, and Scottish Railway Company, the Leeds and Liverpool Canal Company, and the Brierfield Urban District Council had been met or withdrawn, and that only those of owners and occupiers of some of the dwelling-houses within 300 yards radius remained to be heard and considered. The replies to these, of which the Board had received copies, indicated the views of the Corporation; and he only desired to point out, in addition, that this was not a case of establishing new works where none existed, and that the result of successful opposition would only be the concentration upon a restricted site of the same plant and processes, with a possible increase of any objectionable features—thus giving greater cause of complaint than in the alternative case of a conveniently arranged and well-ordered works with ample space.

Alderman *William Fell*, in answer to the Town Clerk, said he was an ex-Mayor of the Borough of Nelson, and was Chairman of the Gas Committee. He had been a member of the Council sixteen years, and resident in the locality all his life. He knew the gas-works at Nelson, and also those at Brierfield. He produced a copy of the Gas Engineer's report for the last municipal year, to which was appended a statistical table covering the period from 1900 to 1923. During that time the quantity of gas made annually at the two works was more than doubled. The total made last year was 519,162,000 c.ft.

Mr. Honey: I see your sale has increased exactly 50 p.ct. since 1912.

Witness (continuing) said the area of the works at Brierfield was about 5 acres, situated on sloping ground immediately above the Leeds and Liverpool canal and adjacent to the London, Midland, and Scottish Railway, from which sidings had recently been constructed for gas-works purposes. The necessity for more land upon which clinker refuse could be deposited had been apparent for some time; and in 1921 a plot consisting of 6¾ acres immediately below the canal was acquired by agreement, and was now used as a dump—the material being transported by means of an aerial ropeway. The Committee having been advised to apply for the Order, took into consideration not only their immediate requirements, but the probable development of the undertaking, and thought it desirable to apply for power to use the land for the manufacture and storage of gas, and also to ask for authority to purchase additional land for other purposes not exceeding 5 acres. With respect to storage he was of opinion that an additional 2 million c.ft. capacity holder would be required in a few years; and when this land was purchased, the Committee thought it would be a very suitable place for a new holder. At the present time the cotton trade—upon which Nelson mainly depended—was not in a flourishing condition; and during last year the rate of development to which they had been accustomed had not been maintained. If, however, by a fortunate chance, the cotton trade should improve, the Committee anticipated a rapid increase in the amount of gas they would have to provide; and in that case additional storage would be indispensable. In any event, it would be an advantage, as there was only one holder at present, apart from the small ones at the Nelson Works, which were of almost negligible capacity for storage purposes. The land in question, from its position and levels, and the character of its surroundings, was certainly very suitable for the purpose. He knew the Brierfield district well, and did not consider the appropriation of this land would cause any nuisance or injury to property there.

Mr. Honey remarked that, in view of the position, it would be hardly wise to put off much longer the erection of an additional holder. As he understood the matter, the Committee were not at the moment proposing to use this land for general manufacturing purposes, either for making gas or for dealing with residuals.

Witness: No, it will be some considerable time before we need to do that, because we have other land on which we can extend.

Mr. Honey next asked the objectors if they wished to make any statement.

Mr. Thompson said they considered the present gas-works in Brierfield were quite sufficient for the neighbourhood, and created quite enough noise and smell to satisfy that neighbourhood. Any extension would cause a depreciation of neighbouring property. The Corporation of Nelson had sufficient land within their own Borough upon which to put the proposed plant, which land, moreover, would enjoy the same railway facilities; while the expense would be no greater than that of adding to the present works in Brierfield. It had been stated that the Committee did not propose to use the land at present. Would it be within the next five years?

Mr. Honey: You have heard Mr. Fell's evidence. Is your objection as much to the construction of the gasholder as to the construction of works for the manufacture of gas?

Mr. Thompson: My only objection is to the manufacture of residual products of coal gas.

The Town Clerk remarked that, it having been reduced to this, he had very little to say. There was no site in Nelson where railway facilities could be obtained such as existed at Brierfield. The very best guarantee all the objectors had that there would be no carbonizing plant or plant of a similar character established on this land, so long as it could possibly be avoided, was the fact that the railway facilities were on the side of the gas-works, and this land was on the opposite side of the canal. It must therefore prove more expensive to use this site than to use the existing site. For many years to come, all the processes necessary could be carried out on the site of the present works, without extending over the canal at all.

Mr. German: My objections are like Mr. Thompson's. I make objection to the fumes and noise and depreciation of property. The houses near the gas-works are let at a lower rent than those farther away.

Mr. Shutt: In the main, the objections I have to submit are the same.

The Town Clerk: So far as I can recollect, there has been no complaint to this Corporation from any property owners in Brierfield.

Mr. Shutt said he understood the Council had complained. The smell had been noticed within the past week.

Mr. *J. Mitchell* said, with regard to the complaint of smell having emanated from the works at Brierfield during the past week, he failed to understand how it was possible for anybody to have noticed any. The plant had been closed down all the summer, and it was only in the last week that they started making gas again. There had been no opportunity of opening the purifier boxes up to the present. There must have been some misunderstanding. The smell could not have emanated from the gas-works. With regard to the noise, he would admit that last year there was considerable noise from the coke conveyor; but this had been remedied during the summer.

Mr. Honey said he proposed to view the site, and would look at the situation of the houses in respect of which objections had been lodged. He was not sure that they could usefully say any more about the matter at the moment. He wanted the objectors to put their case as fully as they desired; and he asked them if they were satisfied that the ground of their opposition had been fully stated.

Mr. German: The Chairman of the Gas Committee says he has a good knowledge of the undertaking. Has he ever lived within 400 yards of the gas-works, so as to get a closer acquaintance?

Alderman *Fell:* No.

The Town Clerk said the purchase price of the land was £1411, including a small sum for costs and stamp duty. The actual sum paid to the vendors was £1350. There was some little compensation to be paid to the tenants before they could get possession, as the ground had been used for agricultural purposes.

Mr. *Mitchell* remarked that he thought £46,000 for a 2 million c.ft. holder was rather on the high side. He thought that from £15 to £17 per 1000 c.ft. would be nearer.

Mr. Honey: It occurs to me that, as you are not proposing to put the holder down at once, the cost may be substantially less than the £46,000 named in the draft Order. It may therefore be better to omit the figure now.

The Town Clerk: The Corporation would be content to leave the question of amount over.

Mr. Honey: You have not yet decided to come under the therm system?

The Town Clerk: We have not—in company with a good many corporations in this district. I think there are many reasons why we should prefer to remain as we are until we are obliged to change over under a general Order of the Board of Trade.

Mr. Honey: I understand the kind of objection that is made; but that does not seem to me to have much force.

The Town Clerk: It is a matter of which I as Town Clerk really have little knowledge.

Mr. Honey: In this matter, you are quite content to be a "back number" here in Nelson?

The Town Clerk: We are prepared to face public opinion, and to take our own course so long as we think it is right,

Mr. Honey: There is no question about the therm system being perfectly fair from the point of view of the consumer. It may give the engineer a little more trouble.

The Town Clerk invited the objectors to proceed to the gas-works, so that they could point out their property, and how they thought it would be affected.

The inquiry then closed.

HYDE GAS COMPANY'S ORDER.

The application of the Hyde Gas Company for a Special Order under section 10 of the Gas Regulation Act, was the subject of an inquiry which was held by Mr. H. C. Honey (Director of Gas Administration at the Board of Trade), in the Company's Offices, Raglan Street, Hyde, last Thursday. The main objects of the Order are to authorize the purchase and utilization of certain lands, the raising of further capital, and the creation of special purposes and renewal funds.

Mr. R. F. Parker (of Messrs. Sharpe, Pritchard, and Co., Westminster) represented the Gas Company; and there were also in attendance Mr. George Evetts (Consulting Engineer, of Westminster), Mr. John Brabbs (Engineer to the Gas Company), Mr. Fred Oldham (Secretary), Mr. G. F. Drinkwater (Chairman), Mr. W. Robinson, (Vice-Chairman), and Mr. Daniel Pennington (Solicitor). Mr. A. J. Lees (of Messrs. Lees and Co., Westminster) appeared for the Hyde Corporation and the Bredbury and Romiley Urban District Council; and there was with him Mr. William Newbigging (Consulting Engineer, of Manchester). The Cheshire County Council were represented by Mr. John Grace (Barrister).

Mr. Parker said the Order was to confer powers of an ordinary nature upon the Gas Company. He might explain, in the first place, that the Company were incorporated by Act of Parliament in 1855; and by that Act they were authorized to supply gas in a certain area, which included the whole of the borough of Hyde, the greater part of the urban district of Bredbury and Romiley, and a small part of the urban district of Compstall. There was another Act passed in 1881. A substantial reduction in the price of gas was being made as from the quarter just commencing; and he believed he was right in saying that the price charged by this Company was the lowest of any company in the immediate neighbourhood. Up to September the prices ranged between 11½d. and 10d. per therm; while the new charges would be from 8¾d. to 7⅝d. per therm. They were a maximum price company, and entitled to pay maximum dividends. They had, as a matter of fact, paid these maximum dividends for a great number of years. The

capital of the Company amounted to about £106,500 in cash. A very small power of issue remained unexercised; but as against this there had been overspent on capital account £6825—the capital outlay being a little short of £114,000. The maximum day's make of gas in 1920 was 1,034,000 c.ft.; in 1921, 994,000 c.ft.; and in 1922, 965,000 c.ft. Thus, there had been a drop, which was, however, doubtless due to industrial depression. As a matter of fact, there was one steel works in the district of which the normal consumption was estimated at 38 million c.ft., but which in 1922 took 1 million c.ft. The real growth of the business was shown by the following figures: In 1900, the sales of gas were 138 million c.ft.; in 1907, upwards of 170 millions; in 1914, upwards of 185 millions; in 1921, over 196 millions; and in 1922, 210 millions. This represented an average of about 3 million c.ft. increase in each year. The Company estimated that there might be an almost immediate increase of 35 to 40 million c.ft. per annum. They further calculated that there would be a total of 114 million c.ft. per annum additional sales by the end of 1933. This would make the yearly sales over 320 million c.ft. The facts he had quoted spoke for themselves; and he did not think he would be boasting in saying that this was a well-conducted Company, selling gas at a low price, and progressive in policy. He had only to turn to the Local Authorities' objections to find a word of praise; for they described the Company as "a well-established Company in an exceedingly sound financial position." The Company possessed a reserve fund which stood at something over £9000, so that it was very nearly full.

There were four principal objects of the Order. The first had reference to new gas lands; and the second was in connection with new share and loan capital. The Order proposed that the Company should have £20,000 of new share capital; and a figure of £46,495 new loan capital. This made, with the small amount (£8419) of unissued capital, a total sum of £74,914. From this it would be necessary to deduct the overspent capital of £6826, which left a net figure available for the future of £68,088. The third object was the establishment of a special purposes fund and a renewal fund; and the fourth, some miscellaneous clauses of a general nature, which were all in common form. With regard to the new lands, some immediately adjoined the existing gas-works—this was the Mill site; while the others were on the opposite side of Raglan Street. In area, they were approximately the same as the existing gas lands. The works at the present time were very congested; and for a long period the Company had been advised by other gentlemen as well as by Mr. Evetts that new gas lands were necessary. With regard to the Mill site, this was the Company's property; but it was at present let on a lease which did not run out for about four years. Thus this land was not immediately available; but that on the opposite side of Raglan Street could be at once utilized. With regard to capital, as he had already said, the present expenditure was £114,000; and the Company wanted an additional £66,495. In the Company's view, and in that of their advisers from time to time, this sum of money would be necessary to enable them to carry on their undertaking in a proper way for the next twelve or thirteen years. An estimate had been prepared in connection with the purposes for which the new capital was required. The principal objects were the extension of the vertical retorts, and the sum of money which the Company regarded as necessary to carry on the undertaking for the period he had just named. They required for lands, buildings, &c., £2000; carbonizing plant, £19,000; exhausters, boilers, and scrubbing plant, £4800; purifiers and purifier shed, £4700; sulphate plant and tar and liquor well, £1800; workshops and sheds, works mains, pumps, &c., £2500—altogether £34,800. With regard to distribution, the figures were: Mains and services, £21,000; ordinary meters, £5600; cookers, £4200; prepayment meter installations, £5000—total, £70,600.

As to the third point of the Order, the Company had a reserve fund under the Gas-Works Clauses Act, and this fund was approximately full. They had also, as appeared from their accounts, set apart a sum of money, which now amounted to £3000, and was really part of the carry forward, for renewal purposes. He thought the Company described it as a fund; but it was not strictly speaking a fund. Probably Mr. Evetts would bear him out in saying it was a very common practice of gas companies to look forward in the matter of heavy expenditure on renewals and maintenance, and to provide for it in some such manner as the Hyde Company had done. The principal expenditure they anticipated when they started this so-called fund was the painting of a gasholder and the replacement of their existing horizontal retorts by verticals. It was proposed that a sum of £4000 should come out of revenue towards these purposes. The special purposes fund was designed to meet expenses incurred by reason of accidents, strikes, or circumstances which due care and management could not have prevented, and to meet the cost of replacement or removal of plant or works other than expenses requisite for maintenance and renewal of plant and works. The Company thought it was a good fund, not only from their own point of view, but from the outlook of the consumers as well. The renewals fund, of course, was to meet expenses of maintenance and renewals, so that it was complementary in nature to the special purposes fund. They suggested that the existing sum set apart out of the carry forward should be absorbed. As to the special purposes fund, he agreed that it was in its origin a sliding scale company's fund; but it had, as a matter of fact, he thought, been granted to maximum price companies quite recently. He suggested Weston-super-Mare as a case in point. The Company regarded it as an advantage that such a fund should be formed. There were many precedents for the renewal fund proposal, both in the last two years and previously. There were Coatbridge, Hexham, St. Austell, and Truro in 1922, and Bromsgrove and Ipswich in the present year. The whole object was to stabilize renewal charges.

Mr. Lees: They are all sliding-scale companies.

Mr. Parker (continuing) stated that amendments had been agreed with the railway companies. The County Council had submitted a long protective clause, which the Company contended was really a complaint against past legislation. The Company had carried on their undertaking ever since 1855 under the Gas-Works Clauses Act, with no special protection to the County Council. If the general law required altering, let it be altered; but at the present time the Gas-Works Clauses Act was the general law, and there was no reason, so far as the Company could see, why the County Council should be put in a different position from that occupied in relation to other gas companies in the county and in relation to gas companies generally throughout the kingdom. The Company could not therefore agree to what the County Council asked for. The last occasion on which this matter was discussed was under the Sandwich Order, 1922. There a clause was proposed by the Kent County Council, and the question was thoroughly threshed out. Generally, the matters in respect of which protection was sought by the County Council were dealt with specifically in the Gas-Works Clauses Act.

Turning now to the objections of the Hyde Corporation and the Bredbury and Romiley Urban District Council, he might say that the Company very much appreciated the tone of the objections. They recognized at once that the Local Authorities were entitled—and it was their duty—to be satisfied in regard to the points they raised. The existing capital expenditure, as he had pointed out, was £114,000; and the Company were asking for something under £70,000 in addition. If this were compared with applications made by other companies recently, he thought the proportion asked for by the Hyde Company would appear to be quite moderate. The Local Authorities, in their objections, took the increase of population as the basis upon which the Company's capital requirements should be estimated. He submitted, with all respect, that this was an absurd basis. The only basis upon which one could calculate capital requirements was the growth of the sales of gas. On the objectors' basis, there had been an increase in population of 18 to 19 p.ct. since 1891; and it would mean that the Company would get something less than one-half of what they were asking for. The sales of gas, on the other hand, had more than doubled in that period. There was a substantial shortage of houses in the district; and when this was met, new connections would be at a greater rate than at present.

Mr. *George Evetts*, M.Inst.C.E. (Consulting Engineer, of Westminster), in answer to Mr. Parker, said he had advised the Hyde Gas Company with reference to this application, and in January of this year visited the works. He then furnished the Directors with a report regarding the most satisfactory and economical manner of extending the works, the estimated cost in connection therewith, and the amount of capital which it would be necessary to raise by means of a Special Order. He had advised the Company to purchase the land scheduled. The capital expenditure at December, 1922, amounted to £113,397; while the gas sold was a little over 211 million c.ft.—representing a capital expenditure of £528 per million c.ft. The gas sold during 1922 was less than in 1920, and less than anticipated, owing to the acute industrial depression in that part of the country. The sale of gas between 1913 and 1920 increased by about 40 million c.ft., equal to 22 p.ct., or a compound rate of about 2¼ p.ct. per annum.

Mr. Lees: In 1914 the sales were 185 million c.ft., and in 1922 210 millions, which was an increase, not of 40 million c.ft., but of 25 millions only. Why stop at 1920, which was three years ago, and which was a boom year?

Witness (continuing) said the capital estimate of £70,600 should provide for an additional consumption of gas of about 100 million c.ft.; and this consumption would be reached in twelve or thirteen years, at a compound increase of roughly 3 p.ct. Quite a substantial proportion—probably some 40 p.ct.—of the increase should come from existing consumers. If all the new business was to come from fresh consumers, it would mean more mains, meters, services, and so on. Therefore £700 per million c.ft. would not provide for all requirements, if the whole demand were to come from new consumers. The present number of consumers per mile of main was 219; but probably new consumers would not be more than 130 to the mile, because obviously the best part of the district was already supplied, and, in addition to this, some new consumers would be expected off the existing mains. He had estimated that, at the end of thirteen years, the over-all number of consumers per mile of main would be 206. The Company had at present sixteen vertical retorts, which were giving great satisfaction. They were built in 1913, and the vertical retort to-day was, of course, a much better carbonizing proposition than it was then; but they were so satisfactory as to point to the fact that the only reasonable development was a continuation of the system. Witness had therefore advised the demolition of the existing horizontal retorts, and their ultimate replacement by a further sixteen vertical retorts, which could be installed eight at a time. A tender had, as a matter of fact, been obtained for the first section of eight new verticals. The interest on the existing capital worked out at 6·58 p.ct. The new capital, most of which would be raised on loan, would be raised at a less average rate of interest than the original capital. In his view, the Company would probably raise the new ordinary capital on a 6½ p.ct. basis. Judging by the results over a series of years, the selling price of gas, and the unvarying maximum dividends, he would say that the undertaking had been well managed from all points of view. The price of gas in 1913 was 3s. per 1000 c.ft., with discounts of 7½ to 25 p.ct. At the present moment it was 3s. 9d., for small domestic consumers; and with the reduction now announced it would be 3s. 1d. So that practically speaking the price after Michaelmas would be the same per 1000 c.ft. as in 1913. He considered the additional capital asked for was unquestionably most reasonable. This £700 per million c.ft. was a very fair figure from after-war experience. It corresponded roughly to £350 in pre-war days; and he did not think that even the Hyde Gas Company could have been developed at less than £350 per million c.ft. before the war. It was his opinion that the time had come when any further growth of the undertaking would need extensive construction and reconstruction. The next installation of carbonizing plant would be substantially in advance of present requirements; but this was what all gas undertakings went through. Heavy capital expenditure usually came in phases; and the Hyde Company had now arrived at a point where money must be spent to some extent ahead of needs. In addition, the capital account was over-spent by £6826. In the period during which the Local Authorities said the population had increased by rather less than 19 p.ct., the gas consumption had gone up 105 p.ct. This showed the fallacy of taking growth in population as a basis for calculating increase in gas consumption. Even should there be not one more house built, there was a very big field in the town for development of the cooking and heating business. A lot of the capital expenditure proposed would go to reduce working costs. There should

be a fund for equalization of repairs in connection with both sliding scale and maximum price companies. It was a highly desirable thing. He was also in favour of the special purposes fund being allowed. It was not given, except in special circumstances, to a maximum price company; but it was something that a renewal fund and a reserve fund did not altogether provide for. If this special purposes fund were allowed, he thought some money should be absorbed in it from the reserve fund. If the Company had the other two funds, they would only need a comparatively small balance in the reserve fund. With the horizontal retorts, making 11,000 c.ft. per ton, the labour costs were 5·45d. per 1000 c.ft.; and with the vertical retorts, making 17,500 c.ft. per ton, the labour costs were 1·18d. per 1000 c.ft. The former figure, of course, applied to the spasmodic way in which the Company had to work their horizontal house—not to full and continuous working.

Mr. LEES (cross-examining): We have it that in 1891 the sale of gas was 103 million c.ft., and in 1922 it was 210 millions. This is an increase of 107 millions in the last 32 years; and it is actually what has taken place. The whole of your case apparently depends upon an estimate that you expect an increase of 100 million c.ft. in thirteen years. Whereas the increase has only been 107 in 32 years, you expect 100 millions in thirteen years. Well, now, Mr. Parker says you should not take population as a basis—it is no evidence at all; but you will agree that population is evidence of the development of a district, and of possible new houses and consumers. You will not dispute our statement that the population here is practically stationary. We were not aware when we put in these figures that one-half the parish of Bredbury, where the population has increased, is in the area of the Stockport Corporation. I put it to you that the population of the area which you supply is practically stationary, and has been for years.

Witness: It appears so from the figures.

You suggest that you will want to spend £70,000 to provide the 100 million c.ft. you are expecting to require; and you very properly say that the estimate is right, if the consumption comes?—Yes; we do not want £70,000 if we have not 100 million c.ft. extra consumption. If things go well in the next year or two, we shall get another 40 million c.ft. consumption without another house being built. Gas furnaces for heating were not thought of 32 years ago, and slot installations were hardly known at that time.

You have a very serious competitor here in the Electricity Board?—I do not think, with gas at 3s. 1d. per 1000 c.ft., we need seriously fear the competition of electricity for heating and cooking.

Witness, in reply to further questions, said he had advised the Company to place the contract for eight vertical retorts as soon as they obtained these powers. The present verticals had a working capacity of about 850,000 c.ft. a day. The Company had to-day substantially more carbonizing plant than they wanted; but it was not of the right type. He could not agree that provision for another 250,000 c.ft. per day would carry them on for ten years or more. There were repairs falling due to the existing vertical retorts. The margin was so slight that the Company would be wise to put in the extra eight retorts. The whole thing depended upon increased consumption; and since July an increase had been made. There was a big field for cookers, as at present slot consumers had grillers only. He could not call to mind a case of a renewal fund being given to a maximum price company.

Mr. LEES: As to mains, services, meters, fittings, &c., how much have you spent on these items, less depreciation, in the last thirteen years? It is practically nothing.

Witness: They might suggest that, because in the past thirteen years there has been no expenditure under these heads, they are going to get it all at once. It proves there is a big field.

You appreciate the difference between the existence of renewal and special purposes funds with a sliding scale company and with a maximum price company? The difference, I suggest, is that in the case of the sliding scale company they are formed out of divisible profits of the company, which they could otherwise distribute among the shareholders. The dividend which the company may pay depends upon the selling price of gas; and if they decide to have these funds for the benefit of the undertaking, the shareholder loses his portion. What would the shareholder lose in the case of a maximum price company? The consumer of such a company must get the profit after the maximum dividend is paid and the reserve fund is full. The effect is to create two other funds, not provided for by the Gas-Works Clauses Act, with money which each year would otherwise have to go to the reduction of the price of gas?—Over a series of years it makes no difference whatever to the consumer. It is to his benefit to equalize repair and emergency expenditure.

You will appreciate that this Company are endeavouring to get certain advantages which a sliding scale company are allowed to obtain, and at the same time to remain a maximum price company; and you cannot give me any precedent at all?—I cannot see how it is injuring the consumer, though I may not be able to give any precedent.

A sliding scale company is a partnership. If you get a well-established company in the fortunate position of this Company, who have paid maximum dividends from the commencement, and have a full reserve fund, there comes a point when they do not know what to do with their money, and must look round for other funds in which to place it?—It does not do the shareholder any good to accumulate these funds. It is entirely for the benefit of the consumer.

Clause 9 gives the Company power to offer capital for subscription, and to pay commissions in connection therewith. If the clause were allowed, it would be waste paper, for two reasons. In the first place, you would never ask the Board of Trade to allow you to make use of it; and if you did, they would not do so. You will agree that the proper course with new capital is that it should be issued by auction or tender?—Yes.

Clause 19 gives the Company power to lay down pipes for ancillary gas purposes within the limits of supply. What is the object of taking this power over the whole of the district? The Local Authorities do not wish to be unreasonable; but they do not want the Company to have power to break-up all the streets for pipes to convey tar, oil, &c. Can you tell me where the Company are likely to want to lay pipes for this purpose?—I cannot; and therefore I do not see why the Local Authorities should worry themselves about the matter.

Witness, questioned by Mr. GRACE, said he would regard Mr. Lees' statement that the roads in this area were honeycombed with pipes as being a fair description. The pipes, of course, might be anything up to seventy years old. There would be a large number of new mains laid in the next thirteen years, and also many renewals of these old pipes.

COUNTY COUNCIL ASK FOR PROTECTIVE CLAUSES.

Mr. GRACE, in answer to Mr. HONEY, gave details of the main roads and bridges in the district for which the Cheshire County Council were wholly or partly responsible. He submitted lengthy clauses which he suggested should be inserted in the Order for the protection of the County Council, and proceeded to question witness as to his views regarding them. Clause 1 read:

(1) All mains, pipes, and works to be laid, renewed, or replaced in or along any main road, or in or upon or across any county or main road bridge vested or repairable by the County Council, shall be laid in such position in or at the side of such road, or in upon or across such bridge, as the County Council in writing under the hand of their surveyor may reasonably direct, and, in the case of mains, pipes, or works laid in or along any such road, at a depth of not less than 3 ft. from the surface of the road to the top of the main pipe or work.

Mr. GRACE: How shallow do you say a pipe should be laid?

Witness: If a pipe is under a footpath, 6 in. is ample.

Mr. HONEY: There are cases in which you get a garage, or something of that kind, on the other side of the footpath.

Witness: I was thinking of a country road, not in a town. Where there might be a garage 6 in. would not do.

Mr. GRACE: This is an industrial district, with heavy traffic. What is your opinion of the depth at which a pipe should be laid now in a road, not under the footpath?

Witness: From 2 ft. 3 in. to 2 ft. 6 in., or a little over, where there is heavy traffic. As a practical proposition, 3 ft. is not unreasonable.

Then we ask for seven clear days' notice, instead of three days; and that the plan required under the Gas-Works Clauses Act shall be accompanied by a description of the work to be done?—A plan and section (which the plan is held to include) should be sufficient for anybody. The word "description" might mean anything.

This particular clause has appeared in dozens of Orders. What we want is the manner of opening the road, the position in the road, and the size of pipe. The diameter of the pipe is of great importance.

Mr. HONEY: I agree with that, but you would get it on the section.

Witness: It might be altered to a dimensioned plan and section, if that would meet the case.

Mr. GRACE: Then we ask that there should be no interference with the structural part of a bridge without the consent of the Council; and that, in the event of our having to improve or alter a road or bridge, the Gas Company should pay the cost of removing a pipe to enable us to do the work.

Witness: If it is for the public convenience, the public should pay for it.

Mr. GRACE then proceeded to go through the remaining proposed clauses, and argued that it was better that there should be one authority to reinstate roads, as the Council asked for.

Mr. HONEY: One of the difficulties is that these clauses have never been put into an Order except by agreement. The general practice being that they are agreed between parties, neither Parliament nor the Board of Trade has gone in great detail into the meaning of any particular obligation that a company have accepted.

Mr. GRACE: One clause provides that we are to be allowed to use steam rollers up to 20 tons in weight.

Witness: That is why you want the pipes 3 ft. in depth. I do not think you should be permitted to use a 20-ton roller over pipes which were laid at a proper depth at the time when they were put down.

Mr. PARKER said that perhaps it would assist matters if he stated that the Company would agree to clause 1, with the words as to specific depth struck out. They would agree to the seven clear days' notice, and to clause 4 modified as follows:

(4) Nothing in this Order shall authorize the Company to interfere with the structural part of any county or main road bridge without the consent in writing of the surveyor of the County Council, which consent shall not be unreasonably withheld.

They would accept clause 6 modified to read:

(6) All works shall be so executed by the Company as not to stop the traffic, and so far as reasonably practicable as not to impede or interfere with the traffic, on any main road or over any county or main road bridge; and the Company shall not open or break-up at any one time a greater length than 100 yards of any such road—not more than 50 yards thereof where their works do not leave sufficient space for two carts to pass at the same time.

The clause relating to non-liability for the 20-ton steam roller they rejected. The other clauses accepted were:

(7) The Company shall pay to the County Council the reasonable costs which the County Council may incur in making good any damage to any portion of a main road or of the road over any county or main road bridge in which works of the Company are or may be laid caused by the concentration thereon of traffic during the laying of any additional works, or the alteration, renewal, or repair of any additional works.

(10) If the Company shall execute any works contrary to the provisions of this section, section 11 of the Gas-Works Clauses Act, 1847, shall (*mutatis mutandis*) apply accordingly.

(11) If (otherwise than in respect of proceedings under section 11 or section 12 of the said Act) any difference at any time arises between the County Council and the Company touching this section, or anything to be done or not to be done thereunder, such difference shall be referred to, and determined by, an arbitrator to be agreed upon between them, or failing such agreement to be appointed on the application of either party by the President of the Institution of Civil Engineers; subject as

aforesaid the provisions of the Arbitration Act, 1889, shall apply to any reference to arbitration under this sub-section.

Mr. Grace: I have consulted with my clients; and they are prepared to accept the offer which has been made by Mr. Parker on behalf of the Gas Company.

Mr. Honey: I should like agreed clauses to be handed in, in the form in which they are to be included in the Order.

The Case for the Local Authorities.

Mr. Lees said that both the Local Authorities for whom he was appearing desired that the Company should be treated by them in a perfectly fair manner. They were not in any way hostile. The Company were old established, and had given a good supply of gas; and what the authorities desired to do was to see that the new powers created were such as were reasonably necessary for them to carry on their business with advantage to the consumers, as well as to the shareholders, during the next ten or twelve years. As to the proposed share and loan capital, they contended that this was altogether excessive. They very strongly objected to the special purposes fund and the renewals fund, and asked that these clauses should be struck out. They also objected on principle to clause 9 (power to offer capital by subscription), and asked that it should be disallowed. It could not be required in the case of the Hyde Gas Company. As to the clause relating to the laying of pipes for ancillary purposes, they did not want the Company to have a roving power to lay these pipes all over the area; and if the clause were given at all, it should be for a limited area round the gas-works. Half-a-mile would be a very good radius, beyond which the Company should not require to go. With regard to the additional share and loan capital, in the first place it was admitted that in 1891 the sale of gas was 103 million c.ft., and that by 1922 it had increased to 210 millions—just more than double. This was a growth of 107 millions in 32 years, or about 3 million c.ft. increase a year. Mr. Evetts suggested that the Company might look forward to an increase of 3 p.ct. per annum. Accepting his figure for a moment, this would give an increase of 6 millions a year; and taking this over ten years—which he believed was a period the Board of Trade considered proper—the increase would amount to 60 millions. He understood Mr. Evetts to say that for the works alone the cost per million c.ft. would be about £350.

Mr. *Evetts:* Rather less.

Mr. Lees said that, taking this figure, the total cost on works for 60 million c.ft. would be £21,000. Then there were mains, meters, services, fittings, &c., for which Mr. Evetts had put down £21,000; but he admitted frankly that this was pure guesswork. Look at what had been the expenditure in past years on these items. He had taken out the figures from the balance-sheet from June 30, 1915, and found the total gross expenditure under this head had been only £1348; but during this period the depreciation allowed had reduced this figure of £1348 to *minus* £555. Then he had asked for figures going a little further back, as he thought it only fair they should have a few years before the war period. The figures had therefore been taken out from 1910; and he found that the total gross expenditure since that year had been £4815, less old fittings sold and depreciation on existing fittings £2565, leaving a net addition to capital of £2250 in thirteen years. In estimating what they were going to spend on this branch of the business in the next ten years, he submitted that regard must be had to what had been spent in the past thirteen years. If the figure of the past thirteen years were added to the £21,000 already mentioned for works, they arrived at a total capital expenditure for the next ten years of £23,250. With the population almost stationary, and no evidence as to new houses being put up, it was impossible to allow any figure approaching £21,000 for new meters, mains, fittings, &c.; in the next ten years; but even giving the Company another £10,000 would only bring the total capital outlay to £33,000. It was difficult to see, on Mr. Evetts' own estimate, how the Company could possibly spend any more. Their available share capital powers were £1800; and if they were given the increase they suggested in the borrowing powers on the capital authorized by the 1855 and 1881 Acts, there would be another £36,000, making a total of £37,800. The Company could not spend this in ten years. If a company had too ample capital powers, they were free from criticism and control for a long period; and this was to be deprecated. To-day Orders were comparatively simple and inexpensive matters; and therefore the former objection of expense in making too frequent applications no longer applied. On the facts of the past which they could not get away from, and on their own figures which he was taking, the Company had not shown a case for the granting of any additional share capital. There never was a clearer case.

It was true that Mr. William Newbigging made a report for the Company in 1907, in which he told them that they wanted a new works; and he estimated £700 per million c.ft. as an all-round figure for these new works and distribution. It was a figure commonly taken at that time. In regard to his ideas of development, it was obvious that Mr. Newbigging had been too optimistic. The Company's present advisers were too optimistic also. In the special purposes fund the Local Authorities saw a matter of principle to which they attached the very greatest importance. He had had Orders himself from which this clause had been struck out; and he did not think they would find a single case of a special purposes fund being included in the powers of a maximum price company. The renewal fund also was formed out of the divisible profits of a sliding scale company. A maximum price company had their reserve fund; and when the reserve fund was full, then under section 35 of the Gas-Works Clauses Act, there must be a reduction in the price of gas. The addition of these funds in this case would be inserting something between the consumer and cheap gas. His clients said the surplus profits must go in the reduction of the price of gas, as they had elected to remain a maximum price company. They desired to be certain of their 10 p.ct., without any risk at all; but at the same time they wanted to secure the advantages that a sliding scale company might get out of these funds, which would be formed from the divisible profits of such a company. They could not take the advantages of a sliding scale company while remaining a maximum price company. All the precedents that had been quoted that morning related to sliding scale companies. Had Parliament thought that maximum price companies should have these funds the necessary provision would have been included in the Gas Regulation Act. Now a word as to the proposed power to offer capital by subscription. In the first place, the Hyde Gas Company would never think of asking the consent of the Board of Trade to issue stock by subscription and allow a commission of 5 p.ct. Here, however, a matter of principle was again involved. To suggest that an undertaking in the splendid financial position of this Company—with £10 shares standing at £27 a share—could not issue their capital by auction or tender, and might have to offer it for subscription and pay a commission of 5 p.ct., was assuming a state of things that did not, and could not, exist. As a matter of fact, there was at the moment a scramble for gas capital. He did not say that with a very small struggling company paying a trifling dividend or none at all, it might not be necessary to do something of this kind; but to suggest that the Hyde Gas Company might have to do it, was not doing any good to the gas industry. The industry was in a better position than this. Next came the question of ancillary pipes.

Mr. Parker: We are prepared to accept a half-mile radius.

Mr. Lees: I am willing to adopt the figures of Mr. Evetts for the purposes of our case; and taking his figures, on his own assumption, I maintain that the Board of Trade cannot say here that the Company's requirements can in any circumstances, within the next ten years, exceed the amount of the additional money they would get from increasing the borrowing powers to one-half. If you, Sir, see fit to do that, well and good. But the amount required does not even reach that figure, unless you throw in another £10,000. That is the case for the Hyde Corporation and the Urban District Council; and I do not think I am justified in taking up your time by calling evidence.

Mr. Parker: I think the whole case is before Mr. Honey; but I had one or two questions I should have asked Mr. Newbigging, if you had called him.

Mr. Lees: Mr. Evetts has been perfectly frank; and I have taken his figures for my argument. Therefore I do not think that I can advance the case by calling Mr. Newbigging; but if you wish to question him, he is here.

Mr. Parker: Mr. Newbigging, in 1907 you gave a figure of £700 per million c.ft.; and if this was right in 1907, would it be increased now?

Mr. *William Newbigging:* It would be increased to the extent of probably £100. It would not be raised by more than this, because in these days you cannot afford to put down works of such a substantial character as these. These works were built very economically; but to-day you would put up a much simpler form of building, and consequently I would not put the additional cost at more than £100 per million. As a matter of fact, taking the case of the vertical-retort installation, you can build it as cheaply to-day as in 1914.

Mr. Parker: You appreciate that Mr. Evetts has worked to-day on a figure of £700. We do not want to add the extra £100. Thus the crux of the whole matter is sales. In 1907 you over-estimated, as it turns out; but Mr. Evetts' estimate to-day for sales roughly speaking coincides with your estimate in that year.

Mr. Lees: If you take a 3 p.ct. increase, it is a mathematical calculation which you cannot get away from.

Mr. Parker: Mr. Evetts does not agree to 3 p.ct.

Mr. *Newbigging:* In this neighbourhood, whether you take Hyde, Stockport, or Manchester, or any of the undertakings round about, it is almost an axiom that the maximum increase in consumption is 3 p.ct. The increase varies from 2 to 3 p.ct. This is borne out by the figures of all these undertakings.

Mr. Parker: But that is not necessarily applicable to a district which is not fully developed.

Mr. *Newbigging:* I should say that Hyde is just as fully developed as the neighbouring towns. Certainly it is as fully developed as we are in Manchester.

Mr. Parker: Mr. Lees seemed to me to ignore what Mr. Evetts said as to the prospects of an immediate increase of 40 to 50 million c.ft. Have you any view as to whether that anticipation is likely to be realized?

Mr. *Newbigging:* I do not think it is likely to materialize.

The inquiry was then closed.

MARPLE GAS ORDER.

On Friday, Mr. Honey proceeded to Marple, to hold an inquiry into the application of the Marple Urban District Council for a Special Order to enable them to purchase a small undertaking supplying gas in part of Compstall and part of Ludworth, at present carried on by the Calico Printers' Association, Ltd., under the Compstall Gas Order, 1909. The second object of the Order is to obtain authority for the acquisition of additional land, for the extension of the gas-works.

Objection was offered by the Railway Companies serving the neighbourhood, by the County Councils of Cheshire and Derbyshire, and by persons owning property in proximity to the works. Among those appearing were Mr. Jacques Abady, who represented the Urban District Council; Sir Harry Courthope-Munroe, K.C., and Mr. H. F. Bidder, for the Railway Companies; and Mr. John Grace, for the Cheshire County Council.

Our report of the lengthy hearing is held over until next week.

Leeds Corporation Gas Exhibit.—The Leeds Corporation Gas Department have two large, well-equipped, and brilliantly lighted stands at the International Fisheries Exhibition at Leeds, from Sept. 24 to Oct. 6, inclusive. In the main hall the stand is a display of general domestic, industrial, and other appliances for lighting, heating, and cooking. In the Fish Friers' Section the display is chiefly of gas appliances for use by the fish-frying industry, including a frying range in use. Many frying range makers have stands at the exhibition; and all have ranges connected up temporarily with gas, in order to demonstrate their use. The normal lighting of the exhibition halls is electric; but the gas lighting at the two stands so completely eclipses the electric lighting of the buildings—and also that which was originally fitted to the stands of exhibitors generally—that the great bulk of the exhibitors have had high-pressure gas lighting added.

THE NORTH-EAST COAST COAL TRADE.

From our Own Correspondent.

The market during this week has been steady, and, in spite of the lack of inquiries which might lead to new business, collieries have been able to maintain their recent quotations.

Congestion at the shipping places has again been serious—an indication of the great volume of export which is taking place on earlier sales, and which is sufficient so far to maintain the steady tone in the absence of new business. In most cases collieries are well sold up to the end of this year, and, so long as those who have bought take out their full quantities regularly, there is no reason to anticipate any drop in the market.

There is every prospect now that the new West Dunston staiths will shortly be available for use, and this will give extra shipping facilities which, it is hoped, will do much towards the relief of congestion. This is especially so in the case of the collieries whose nearest shipment place is the old Dunston staiths. Owing to the serious position here, they have had to send big quantities of coal by rail further down the river, which has added at least a shilling to the f.o.b. cost. The three new berths at West Dunston were completed just before the war, but never put into use. It is hoped now that the L. & N.E.R., to whom they belong, have realized the need there is for opening them out.

The price of best quality gas is about 24s., and seconds 22s. f.o.b. At this price—or any other for that matter—scarcely any business is passing. In the uncertainty of the Ruhr situation, sellers frankly confess that they cannot tell whether there is to be a boom or a slump. Would-be buyers come back sometimes with counter-offers to the 24s. price at 20s. or 21s., and indicate that they might be able to place business at this figure. But collieries prefer to hold their coal for the present.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From a Local Correspondent.

The gas coal market in Yorkshire and Lancashire remains firm, which is nothing abnormal; this being the period of the year when authorities usually put a little to stock in order to cover eventualities during the winter. There is a natural improvement in the demand for house coals, particularly of the better description. The secondary descriptions are also moving freely. There is little or no improvement in the demand for industrial coal, though collieries are working full time. There is some small slack for sale, probably due to the lack of facilities in regard to export.

The export section varies from day to day; and while orders from Germany are restricted, there is still a certain amount of business flowing to that country. France and Belgium are also taking their usual supplies, although they do not buy far ahead on account of a possible settlement in the Ruhr and an alteration in the rates of exchange. Prices remain unchanged.

COAL TRADE IN THE MIDLANDS.

From our Local Correspondent.

Business does not show much re-invigoration in this district, except as regards the trade in household fuel. This is more active, but not disproportionately so for the season. The winter prices took effect at the beginning of October—some collieries ante-dated the change by a week. They vary considerably, but generally range between the limits of 1s. and 2s. 6d. Industrial fuel is in no better request. Deliveries of gas coal are steadily maintained. There is a recurrence of the complaints of transport irregularities. No real difficulty is experienced, of course, in handling the present volume of traffic; but dislocations result from delays in the clearance of wagons. Slacks and steam coals are in poor request, and values are not moving in favour of the seller.

Blast-furnace owners are still pressing urgently for relief in the cost of coke. A further conference has been held with the suppliers in the Lancashire, Yorkshire, Derbyshire, Nottinghamshire, and Staffordshire area, with the result that the price at ovens has been reduced from 26s. to 24s. as from Oct. 1. Arrangements have been made for a further review of the situation in a few weeks; smelters holding that the reduction is not enough to aid materially in re-animating the pig iron industry. Welsh coke is reported to have been sold in the district at rather lower prices than those lately ruling. Foundry coke is likewise easier.

Lewes Gas Company.—A general meeting of the Lewes Gas Company was held on Sept. 20—Mr. Edward Monk (the Chairman) presiding. The Directors' report stated that for the half-year ended June 30 the revenue account showed a profit of £2493; and after providing for the usual charges, the net revenue was £2260. The Directors recommended dividends for the half-year at the rate of 5 p.ct. upon the original capital stock and 3½ p.ct. upon the additional capital stock. The Chairman observed that the accounts that day were a particularly plain proposition. Gas was now 16d. per therm, where formerly it was 18d. In regard to the dividend, force of circumstances in the past, and a conservative policy which had commended itself to the Directors, had doubtless lowered the dividend for some considerable time. The full dividend had not been paid since September, 1915; and it was a matter of pleasure to Directors and shareholders alike that they were in a position that day to again declare the old dividend. Mr. Oke, who seconded, felt they were getting a return to the prosperity which the Company had enjoyed for many years. The report and balance-sheet were adopted, and the dividends recommended were declared.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *Oct.* 1.

The market for tar products remains without particular change. For some time past the price of pitch has been nominal, and practically no business offering. More interest is being taken again now, and it is reported that a certain amount of business has been done in the neighbourhood of 130s. per ton; but the tendency is firmer to-day. Creosote is a steady market at from 9¾d. to 10d. per gallon. Tar spirits are dull, and have not been assisted by the recent drop in petrol. Pure benzole is about 1s. 7d. per gallon, pure toluole about 1s. 10d. per gallon, and 95-160 solvent naphtha about 1s. 6d. to 1s. 7d. per gallon; but there is very little demand. Other products are without change.

Tar Products in the Provinces.

Oct. 1.

There has been little doing in tar products during the past week. Pitch is quiet; and although prices are nominally unchanged, there is a feeling that we may have Continental inquiries at an early date. Creosote is steady, with a fair demand for delivery this year. Water white products are all very depressed, and sales are difficult to negotiate. Carbolic acid remains firm; but there is a difficulty in marketing crystals for delivery beyond October or November. Naphthalene is quiet; but there has been a little inquiry for delivery to the end of the year.

The average values for gas-works products during last week were: Gas-works coal tar, 73s. to 78s. Pitch, East Coast, 125s. to 127s. 6d. f.o.b. West Coast—Manchester, 121s. 3d. to 124s. 9d.; Liverpool, 122s. 3d. to 125s. 9d.; Clyde, 122s. 3d. to 125s. 9d. Benzole 90 p.ct., North, 1s. 2½d. to 1s. 3½d.; crude 65 p.ct. at 120° C., 10d. to 10¼d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 5d. to 1s. 7d. Toluole, naked, North, 1s. 7d. to 1s. 8d. nominal. Coal tar crude naphtha in bulk, North, 8d. to 8¼d. Solvent naphtha, naked, North, 1s. 2¼d. to 1s. 4d. Heavy naphtha, North, 1s. 5¼d. to 1s. 7¼d. Creosote, in bulk, North, liquid, 8d. to 8½d.; salty, 7½d. to 8d.; Scotland, 6¾d. to 7¼d. Heavy oils, in bulk, North, 8¼d. to 9d. Carbolic acid, 60 p.ct., 3s. 4d. to 3s. 5d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

In their usual monthly report (issued on Sept. 26), Sir S. W. Royse & Co., Ltd., say: The market for tar products remains practically unchanged. Benzoles and toluoles have been in only moderate demand; but the further reduction in petrol should have the effect of stimulating business. Solvent naphtha remains quiet; the small orders passing are keenly competed for, and lower prices have been taken. Creosote continues steady, with supplies scarce, and fair quantities are being exported. Crude carbolic acid remains firm with little offering. If anything, naphthalenes have a better tone, but little is being done in the refined product—the inquiry being principally for crude. In pitch, market conditions are still difficult, and business has been consequently limited. Lower values have been accepted both for export and South Wales. There is nothing to report in sulphate of ammonia.

New Companies Registered.—Clayton-Murdoch Gas Appliance is the title of a Company registered, with a capital of £75,000, to acquire from Messrs. Todman, Ryall, and Co. (*a*) the benefit of a gas-switch invention and appliance and the British rights therein; (*b*) the British rights of manufacture of the "L.W." dynamo; and to carry on the business of engineers. The office is at Capel House, New Broad Street, London, E.C. The New Stimex Gas-Stove Company has been registered, with a capital of £25,000, to carry on the business of makers of gas-stoves and circulators, boiler ranges, enamelled ware, machinery, and hardware. The address is Stimex House, Balham Hill, London, S.W.

A One-Lamp Town.—A curious decision on lighting has been arrived at by the Urban Council of Warrenpoint—the popular co. Down watering place. The Gas Company had tendered at £2 10s. per lamp for 45 lamps for town lighting during the winter (a reduction of 7s. 6d. on last year), and at £2 for the full number of lamps, 68. The Council expressed dissatisfaction with the price; and the Company, in a fresh tender, offered to undertake the lighting at 10s. for the first 1000 c.ft., and 6s. 8d. for every subsequent 1000 c.ft. A resolution was proposed that only one lamp be lighted—that in the public square—subject to the opinion of the Council's solicitor as to liability for accident arising from non-lighting elsewhere. An amendment was moved for the lighting of 68 lamps; but this was rejected by a majority of one, and the motion to light only the lamp in the square was declared carried. The result has given rise to much dissatisfaction among the ratepayers.

Cast-Concrete Gas-Flues.—Major F. Cornelius Wheeler, of the Nautilus Fire Company, Ltd., lately delivered a lecture in the Swansea Gas Light Company's drawing office, in which he explained the benefits of gas heating, and pointed out that the gas-fire is probably the greatest labour-saving device that has ever been brought into the home. Subsequently the advantages of the "Nautilus" cast-concrete gas-flue system were thoroughly dealt with, and illustrations of various modern buildings showing the structural savings and financial economies effected by this method were exhibited to the audience. Several local architects were present, and a discussion took place at the conclusion of the lecture; some very interesting questions being raised. Two important building contracts—*i.e.*, new premises for Messrs. Pascoe & Price Rees—are being carried out at Swansea under the direction of Messrs. Blewitt, Jenkins, & Co. (architects), in which a number of gas-fires and the "Nautilus" cast-concrete flue system have been installed.

Reduction in Price at Tipton.—The Tipton Urban District Council have reduced the price of gas by 3d. per 1000 c.ft. They have also decided that, from the September quarter, the charges for power gas be 3s. 9d. per 1000 c.ft., or 10d. per therm, under 100,000 c.ft., and 3s. 6d., or 9·4d. per therm, over that quantity.

Merthyr Gas-Works Strike.—Thirty union men employed at the Merthyr Tydfil Gas Company's works came out on strike some days ago. They demanded the reinstatement as a leading stoker (from which position he had recently been removed) of a man named O'Brien, who was the Secretary of the men's branch of the Union. Volunteer labour was forthcoming to maintain the gas supply. The men subsequently agreed to return to work pending a meeting between the Directors of the Company and representatives of the employees.

Cheaper Gas for Keighley.—Cheaper gas is in prospect at Keighley, where the Gas Committee recommend a reduction for all purposes, both inside and outside the borough, by 5d. per 1000 c.ft., making the price 2s. 11d. (less 5 p.ct. discount). Keighley's lowest price for gas was 1s. 11d. from January, 1911, to June 30, 1915. The net profit for the year ended June 30 last was £13,575; the gross profit (£21,749) being £15,173 more than that of the previous year. The Committee recommend the transfer of £4550 (the estimated cost of street lighting) to general district rate relief, £7207 to working capital account, £6368 to the reserve or renewals fund, and a donation of £100 to the hospital.

Congleton Gas-Works Control.—At a meeting of the Congleton Town Council recently, Alderman Jolly called attention to a recommendation of the Gas Committee that one of the fitters at the gas-works be dismissed. He did not think the Council were proceeding on business lines in taking the authority to engage or dismiss men at the works out of the hands of the responsible Works Manager. This was not done in the other Corporation departments; and why the practice should obtain only with regard to the gas-works, he did not know. The Manager was the proper official to deal with such matters; and he moved that the Committee's recommendations be referred back. After a little discussion, in which it was pointed out that, for the Gas Committee to dismiss men was undermining the authority of the Manager, the resolution was agreed to.

Kidderminster Gas Company.—Mr. G. W. Grosvenor, presiding at the half-yearly meeting of the Company, congratulated the shareholders on the satisfactory results of the trading. Since July, 1922, the price of gas had been reduced to 1s. per therm, or its equivalent of 4s. 6d. per 1000 c.ft. With regard to public lighting, the Company had always endeavoured to keep the streets lighted with the latest type of gas-lamp; and they hoped the time was not far distant when the Corporation would revert to the old conditions, and continue lighting the public thoroughfares throughout the year. They maintained that, if this were done, the cost to the ratepayers would be no greater than the pre-war charge for public lighting for the present number of lamps. The Directors and staff were thanked, and the hope expressed that gas prices would be still lower in the near future.

The Buckhaven and Leven Gas Commissioners, having had placed before them a satisfactory financial statement, have decided to reduce the price of gas from 6s. 4d. to 5s. 10d. per 1000 c.ft.

Serious inconvenience was caused to a number of tradesmen in Sudbury last Saturday week by the sudden failing of the electric light. In some instances candles and lamps had to be requisitioned to carry on business. The stoppage was due to the bursting of a pipe. Recently the power station has been working to its utmost capacity; and with the advent of normal time, the demand proved greater than the supply. Two more engines are being installed.

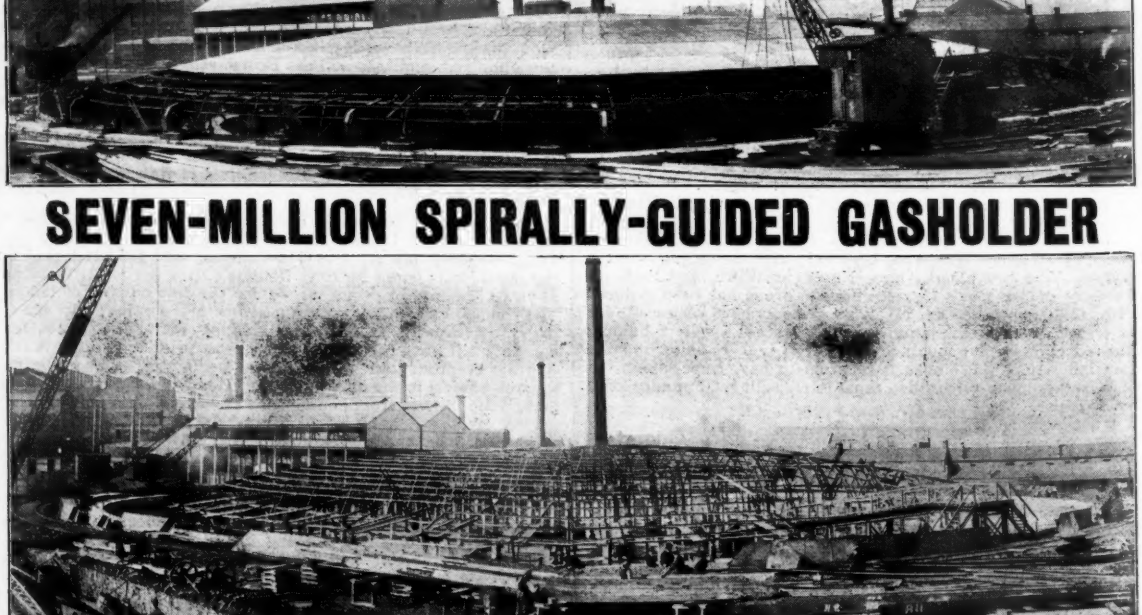
The Batley Corporation Gas Department are to hold a special exhibition of domestic gas appliances, at the Town Hall, from Oct. 10 to 18, inclusive. The exhibition will be opened by the Mayor (Councillor Hamilton Crothers); and there will be demonstrations and lectures daily—especially on the use of gas-cookers, by Mr. R. Gamble Marks. All domestic gas appliances sold during the exhibition period will be at cost price, and be fixed free up to 20 ft. of piping.

When people are using carnival decorations and gas illuminations, they have sense enough to take ordinary precautions. When they employ electric lighting, they tend to forget what will happen if there should be a fuse. This is what occurred on the third day of the Morecambe Carnival Week, from Sept. 15 to 22, at the Queen's Hotel, where an electric wire, for night illuminations, fused amid a mass of paper flowers and other decorations. The decorations, of course, were quickly consumed; and the whole building was in serious danger. The fire brigade, however, got control with remarkable skill.

The Skipton District Council are evidently having some trouble with their gas consumers in the matter of payment. The Gas Committee think the matter so serious that they have reached the following drastic decisions: That no new account be opened without full investigation and references as to the financial stability of the persons requiring credit; that, in future, payments of accounts be made by the 14th of each month, and that the Accountant and Manager be instructed to arrange for customers being informed of this; and that if the department's accounts are not paid to the Accountant by that date, he must inform the Manager, who must at once stop supplies.

Mr. C. S. Shapley (the Leeds City Gas Engineer and General Manager), whose department have just changed to the therm system of charging, has issued for distribution to consumers a neatly printed circular, explaining in sympathetic and friendly terms the basis of the new system of charging, and undertaking that the gas accounts in future shall be expressed both in cubic feet and in therms. The circular does a little sum in arithmetic, showing that the new method does not involve an increase in price, and ends by stating: "The policy of the Gas Committee is to supply gas at the cheapest possible price; and they hope in the near future to be able to announce a further reduction."

SEVEN-MILLION SPIRALLY-GUIDED GASHOLDER



R. & J. DEMPSTER, LTD., MANCHESTER.

LONDON OFFICE: 34, VICTORIA STREET, WESTMINSTER, S.W. 1.

STOCK MARKET REPORT.

A more cheerful tone prevailed on the Stock Exchange at the beginning of last week. On the definite announcement that Germany had abandoned passive resistance on the Ruhr, the franc and allied currencies substantially improved, and the improvement was reflected on the Exchange. French Rentes and similar securities and Home Government Stocks were prominent. On Wednesday, however, a reaction set in, and "hesitation" describes the condition of the markets generally, which for the remainder of the week were on the dull side. Business was also affected by the distribution of allotments in respect of the new Victoria 5 p.ct. Loan. Owing to the fact that applicants received about 30 p.ct. of the amount applied for, there was a keen demand for the new scrip, for which as much as ⅝ premium was paid.

The following companies' quotations showed variations: Bombay, Bristol max., Cape Town debenture, European and South Metropolitan improved; and Imperial Continental and Sheffield "B" and "C" stocks declined. The transactions recorded were: Monday, Aldershot 4 p.ct. consolidated preference 74½, 75, Alliance and Dublin consolidated 73, British Gas Light "A" 13½, Commercial 4 p.ct. capital 96, European 7⅞, 8½, Gas Light and Coke 97, 97⅛, 97⅜, 97⅝, 4 p.ct. consolidated preference 81⅛, 81⅜, 3 p.ct. consolidated debenture 62½, Imperial Continental 162½, 163½, 164, Lea Bridge 98, South Metropolitan 99, 6½ p.ct. debenture 105½, Wandsworth (Epsom) 5 p.ct. 114. On Tuesday, British "A" 13, Commercial 4 p.ct. 97, European 7¾, Gas Light and Coke 4 p.ct. 97, 97⅛, 97⅜, 97⅝, 97¾, 3 p.ct. debenture 62½, 64, Hastings and St. Leonards 3½ p.ct. 80½ *ex div.*, Imperial Continental 165, Primitiva 7s., 5 p.ct. pref. 30s., 30s. 9d., South Metropolitan 99 South Suburban 5 p.ct. 102, Tottenham "B" 3½ p.ct. 103, Southgate 7 p.ct. maximum 105. 106, 5 p.ct. preference 89. On Wednesday, Bombay 5⅛, Brentford "A" 103⅜, "B" 103½, Brighton and Hove "A" 130, 131½, Commercial 4 p.ct. 96, 96⅛, 3½ p.ct. 96, 96⅛, Croydon 102½, Gas Light and Coke 96⅞, 97, 97⅛, 97⅛, 4 p.ct. consolidated preference 81½, 81⅝, 82½, Hastings and St. Leonards 3½ p ct. 80 *ex div.*, Imperial Continental 163, 164½, 165 165½, Lea Bridge 98, 99, Primitiva 7s., 5 p.ct. preference 30s., South Metropolitan 98, 99. South Suburban 101⅛, Wandsworth 3½ p.ct. "B" 113½, 114, (Wimbledon) 5 p ct. 111, Cheltenham 5 p.ct. maximum 72½, Swansea 5 p.ct. maximum 84½, 84⅜ On Thursday, Brentford 3½ p.ct. "B" 102⅜, British Gas Light "A" 13½, Croydon 103½, European 8⅛, 8 7/16, Gas Light and Coke 4 p.ct. 96½, 96⅜, 97, 97⅛, 97½, 4 p.ct. consolidated preference 81½, 81⅛, 3 p.ct. debenture 62½, 63. Imperial Continental 163, 3½ p.ct. debenture 76⅜, Montevideo 48, Primitiva 8s., 6s., 5 p.ct. preference 30s., 31s., South Metropolitan 98½, South Suburban 5 p.ct. 101½, Wandsworth (Wimbledon) 5 p.ct. 112, Croydon 4 p.ct. debenture 78½, Southend 5 p.ct. New "B" 89, 91, Wandsworth New 3½ p.ct. 102. On Friday, British 13, Commercial 4 p.ct. 96⅞. 3½ p.ct. 95½, 3 p.ct. debenture 60½, European 8 1/16, 8⅛, Gas Light and Coke 4 p.ct. 96⅞. 96⅜. 97. 3½ p.ct. maximum 66½, 67, 4 p.ct. consolidated preference 82½, 3 p.ct. debenture 62⅝, 63⅜, Imperial Continental 160, Primitiva 6s, 5 p.ct. preference 28s. 9d., South Metropolitan 98½, 98⅝, South Suburban 5 p.ct. 101⅛, Swansea 6½ p.ct. debenture 105½, Barnet "A" 155½, 156¼, British "B" 12, Croydon 4 p.ct. debenture 79⅜, Southgate 10 p ct. ordinary 144.

Considerable demand for money was experienced during the latter part of the week to carry over into October, and the pressure was accentuated by the usual quarterly window dressing—3½ p.ct. being paid in some instances over the week end. Discount rates were steady. The appreciation in silver which occurred in the previous week was not maintained, and the price fell gradually, closing on Friday at 31⅛d. per oz. for cash.

The Bank of England rate remains at 4 p.ct., to which figure it was raised from 3 p ct. on July 5.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S TRANSACTIONS.

Issue.	Share.	When ex-Dividend.	Ante-War Dividend & Bonus.	Last Divid. at Rate of	NAME.	Closing Prices, July 30, 1914.	Variation. Present Quotations.	Variation. Lowest and Highest Prices of Transactions.
£			p.c.	% p.a.				
132,978	Stk.	Aug. 9	—	5	Aldershot 5 p.c. max. C.	..	72—77	...
217,992	,,	,,	4	4	Do. 4 p.c. Pref.	..	70—75	74½—75
1,551,868	,,	Apl. 5	2½	5	Alliance & Dublin Ord.	59—64	62—67	...
374,000	,,	July 12	4	4	Do. 4 p.c. Deb.	76—79	72—77	73
180,000	5	May 17	7½	8	Bombay, Ltd.	5⅛—6⅛	5⅛—5⅜	5⅛
100,000	10	Aug. 9	16	8½	Bournemouth Gas and Water — 5 p.c.	..	12⅛—12⅝	...
383,110	10	,,	7	7	Bournemouth Gas and Water — Pref. 6 p.c.	13—15⅛	11⅝—12⅛	...
115,000	10	,,	6	6	Bournemouth Gas and Water — 4 p.c. Deb.	13½—14	10⅛—11⅛	...
162,025	—	June 28	..	4	Brentford A Consolid.	..	77—82	..
992,045	Stk.	July 12	14	6 1/10	Do. B New	261—266	100—105	103⅛
734,920	,,	,,	11	6⅛	Do. 3 p.c. Pref.	204—209	100—105	102⅛—103⅛
55,000	,,	,,	5	5	Do. 4 p.c. Deb.	109—111	83—88	...
221,400	,,	June 14	4	4	Brighton & Hove Orig.	91—93	77—82	...
214,745	,,	Aug. 23	11	11½	Do. A Ord. Stk.	208—213	171—176	...
244,200	Stk.	July 26	8	8⅛	Bristol 5 p.c. max.	154—159	127—132	130—131½
1,287,500	20	Mar. 22	5	5	British A Ord.	..	95—96	..
570,000	10	June 28	12½	10	Do. 7 p.c. Pref.	44—45	12⅜—13⅜	13—13⅜
100,000	Stk.	,,	—	7	Do. 4 p.c. Deb. Stk.	..	11⅜—12⅜	...
120,000	10	May 17	4	4	Cape Town & Dis., Ltd.	88—90	75—80	...
100,000	10	May 3	—	7	Do. 4½ p.c. Pref.	1⅛—2⅛	6¼—7⅛	...
100,000	10	June 28	4½	4½	Do. 4½ p.c. Deb. Stk.	4—6	6—7	...
150,000	Stk.	,,	—	7⅛	Cardiff 7½ p.c. Deb.	70—75	75—80	...
237,860	,,	Feb. 26	5	5	Chester 5 p.c. Ord.	..	106—111	...
157,150	,,	July 25	5/9/4	6	Commercial 4 p.c. Stk.	108—110	..	...
1,313,280	,,	,,	5⅛	6	Do. 3½ p.c. do.	106—108	95—98	96—97
360,000	,,	June 14	3	3	Do. 3 p.c. Deb. Stk.	103—105	95—98	95⅛—96⅛
475,000	,,	14 Jan. 15	4	—	Continental Union, Ltd.	69½—71½	60—64	60½
800,000	,,	Dec. 14	7	7	Croydon sliding scale.	76—79	33—38	...
200,000	,,	Aug. 9	—	6½	Do. max. div.	..	72—77	...
660,000				5	Derby Con. Stk.	115—118	102—104	102½—103½
284,975		,,	—	4½	Do. Deb. Stk.	..	81—85	...
492,270	Stk.	—	6	4	East Hull 5 p.c. max.	123—125	..	...
55,000	,,	—	4	4	European, Ltd.	102—104	..	...
209,000	,,	Apl. 5	—	5	Gas, Light and Coke — 4 p.c. Ord.	..	..	...
1,002,180	10	July 12	10	5	Gas, Light and Coke — 3½ p.c. max.	17½—18	8—9	7⅜—8 7/16
16,546,120	Stk.	July 26	4/17/4	5½	Gas, Light and Coke — 4 p.c. Con. Pref.	98—102	96—98	96⅜—97⅜
2,600,000	,,	,,	3½	3½	Gas, Light and Coke — 3 p.c. Con. Deb.	76—79	65—68	66½—67
4,062,235	,,	,,	4	4	Gas, Light and Coke — 10 p.c. Bonds	96—99	80—83	81⅛—82½
4,761,930	,,	June 14	3	3	Gas, Light and Coke — 7½ p.c. Ilford Deb.	72½—74½	61—64	62½—64
130,000	,,	Dec. 11	10	10	Hastings & St. L. 5 p.c.	..	..	...
42,000	—	—	—	7½	Do. 3½ p.c.	..	93—98*	...
82,500	,,	Sept. 19	5	6⅛	Hongkong & China, Ltd.	87—89	78—83*	80—80½xd.
258,740	,,	,,	5½	5½	Hornsey 7 p.c.	16½—16⅝	15—16	...
70,000	10	May 17	11	10	Imperial Continental	..	144—149	...
86,600	Stk.	Aug. 23	9	9½	Do. 3½ p.c. Deb. Red.	150—160	158—163	160—165
1,976,000	,,	May 31	9	17	Lea Bridge Ord. 5 p.c.	84—86	76—78	76½
401,400	,,	Aug. 9	3½	3½	Liverpool 5 p.c. Ord.	119—121	95—100	98—99
835,242	,,	,,	6½	6½	,, 7 p.c. Pref.	—	..	...
1,127,240	,,	Feb. 26	10	5½	Maidstone 5 p.c.	..	103—106*	...
600,000	,,	Sept. 19	—	7	Do. 3 p.c. Deb	..	104—109	...
165,736	,,	Aug. 23	7/5/6	4½	Malta & Mediterranean Met. of Melbourne — 4½ p.c. Deb.	..	52—57	...
63,480	,,	June 28	—	—	Montevideo, Ltd.	4¼—4⅜	3¾—4	...
75,000	5	June 14	6	7	Newcastle & Gatsh'dCon.	99—101	97—100	...
50,000	100	Apl. 3	4½	4½	Do. 4 p.c. Pref. Stk.	11⅛—12	49—54	4⅜
541,920	Stk.	May 17	4	4	Do. 3½ p.c. Deb.	98⅛—99⅛	83⅛—84⅛	...
1,875,892	,,	July 26	4½	4½	North Middlesex 10 p.c.	..	74⅛—76⅛	...
250,166	,,	Aug. 9	—	4	,, 7 p.c.	82—83	71—73	...
329,705	,,	June 28	3½	3½	Oriental, Ltd.	..	16⅛—17⅛	...
15,000	10	Aug. 23	—	11	Plym'th & Stonh'se 5 p.c.	14—15	11⅛—12⅛	...
75,940	10	,,	7/14/0	7 7/10	Portsea Island, B	117—122	97—102	...
300,000	Stk.	May 3	8	7	Do. C	..	108—113	...
138,120	Stk.	June 28	—	7½	Primitiva Ord.	128—131	100—105	...
60,000	50	Sept. 6	13	13	Do. 5 p.c. Pref.	118—121	97—102	...
100,000	50	,,	12	12	Do. 4 p.c. Deb.	5⅛—6	⅞—1	6/—8/-
1,450,345	5	29 Oct. 14	8	—	Do.	4⅛—5	1⅛—1⅛	28/9—31/-
2,199,800	5	30 Dec. 15	5	—	Do.	91—93	70—74	...
341,400	100	June 1	4	4	Do.	..	56—59	...
600,000	Stk.	July 26	4	4	Do.	85—87	56—59	...
220,335	,,	June 28	4	4	Do.	85—87	56—59	...
321,670	,,	,,	4	4	Do.	10⅜—11	5⅛—6⅛	...
150,000	10	Mar. 22	6	6	Do. B. Aires 4 p.c. Deb.	47—49	38—41	...
125,000	50	July 2	5	5	Do. Riv. Pl. 4 p.c. Deb.	223—224	102—104	...
270,000	Stk.	Aug. 23	10	5	San Paulo — 6 p.c. Pref.	222—224	101—103	...
419,968	,,	,,	10	5	San Paulo — 5 p.c. Deb.	220—222	99—101	99⅛
1,047,000	,,	,,	10	5	Sheffield A	..	..	...
133,201	Stk.	—	4	6	Do. B	101—111	71—91	...
90,000	10	May 31	9	9	Do. C	111—113	97⅛—99⅛	98—99
6,609,895	Stk.	July 26	5/4/0	5	Shrewsbury 5 p.c.	..	98—100	...
250,000	,,	July 12	—	5	South African	72½—74½	61—64	...
1,895,445	,,	,,	3	3	South Met. Ord.	..	105—107	105⅛
734,000	,,	Sept. 6	—	6½	Do. Red. Pref.	157—159	137—129	...
91,500	,,	Aug. 23	8½	8½	Do. 4 p.c. Deb.	114—116	100—103	101⅛—102
1,087,795	,,	,,	6	6	South Shields Con. Stk.	116—118	95—100	...
368,837	,,	June 28	5	5	S'th Suburb'n Ord. 5 p.c.	99—102	88—91	...
647,740	,,	May 3	5	7	Do. 5 p.c. Deb. Stk. max	..	72—77	...
121,275	,,	June 28	4	4	S'th'mpt'n Ord. 5p.c. Deb. Stk.	..	102—104	...
250,000	,,	Aug. 23	—	7	Do. 4 p c. Pref. Stk.	..	105—107	105⅛
200,000	,,	June 28	—	6½	Swansea 7 p.c. Pref. Stk.	..	120—125	...
120,000	,,	July 26	—	8	Do. 6½ p.c. Deb. Stk.	135—138	100—105	103
782,875	,,	,,	6	6½	Tottenham and District — A 5 p.c.	115—117	78—82	...
181,855	,,	June 14	4	4	Tottenham and District — B 3½ p.c.	87—89	88—90	...
258,251	Stk.	Aug. 23	5	5	Tottenham and District — 4 p.c. Deb.	108½—109	..	...
					Tynemouth 5 p.c. max.	..	126—131	...
30,000	,,	July 12	8½	9	Wandsworth, Wimbledon, and Epsom—	151—156	129—134	113½—114
235,636	,,	,,	6½	7½	Wandsworth A 5 p.c.	129—134	..	...
108,075	,,	,,	—	6 7/10	Do. B 3½ p.c.	..	109—114	111
140,865	,,	,,	—	6 7/10	Do. C.	..	112—117	114
332,000	,,	,,	6½	7½	New Ordinary	117—122	57—60	...
98,000	,,	,,	6½	7½	Wimbledon 5 p.c.	121—126	..	..
88,416	,,	June 28	3	3	Epsom 5 p.c.	66—69	..	..
					5 p.c Deb. Stk.			

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